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The Mason Steam Damper Regulator.

The accompanying cuts represent the exterior and sectional views of a novel steam damper regulator, recently placed on the market by the Mason Regulator Co., of Boston. From the outside view it will be readily seen that it is only necessary to set the regulator in some convenient position, and attach by a chain to the damper, while a connection is made with the boiler by means of a small pipe. The pressure desired to be carried can readily be changed by turning the key shown at the top.

The practical working of the regulator is as follows, referring to the letters shown on the sectional view. The boiler pressure, which is connected at the pipe *C*, comes into the chamber *E*, the top of which is formed by a diaphragm, on which rests the main spring *S*. If the boiler pressure rises above the required point, or sufficiently to overcome the tension of the spring *S*, the diaphragm is raised very slightly and the steam passes down the passage *X*, to the upper surface of the piston *D*, which it forces down. This piston being connected with the wheel on the shaft *H*, by a chain or rack and pinion, turns it around, communicating a like motion to the outside wheel, and thence to the damper in the flue.

When the boiler pressure falls, the diaphragm comes on to its seat, which covers the passage *X*, and steam pressure is removed from the top of the piston *D*, while the weight on the damper brings the wheel *P* back to its original position.

It is the general opinion among engineers that a regulator which suddenly opens or closes a damper to its full capacity wastes coal, which is undoubtedly true; therefore, a device, which is known as a compensating lever is provided, in the lever *M*, which rests on the cam *L*. As the shaft *H* turns, the lever is thrown over and works a cam *K*, which changes the tension on the main spring, immediately the regulator commences to act. By this means it is found that the damper is kept more constant and the draft steady. The regulator can be furnished either with or without the compensating lever, as desired. It is entirely made of the best steam metal.

The attempts of late years to build fireproof buildings reminds one of the old problem of the irresistible force brought to bear on the immovable mass. Just now the outlook seems to be that there are no fireproof buildings. Proper precautions against fire, and ready means for extinguishing it, are the only safeguards. For lack of these, a great many manufacturing establishments are destroyed every year. The problem of avoiding fires is worthy of a great deal more attention than it receives.

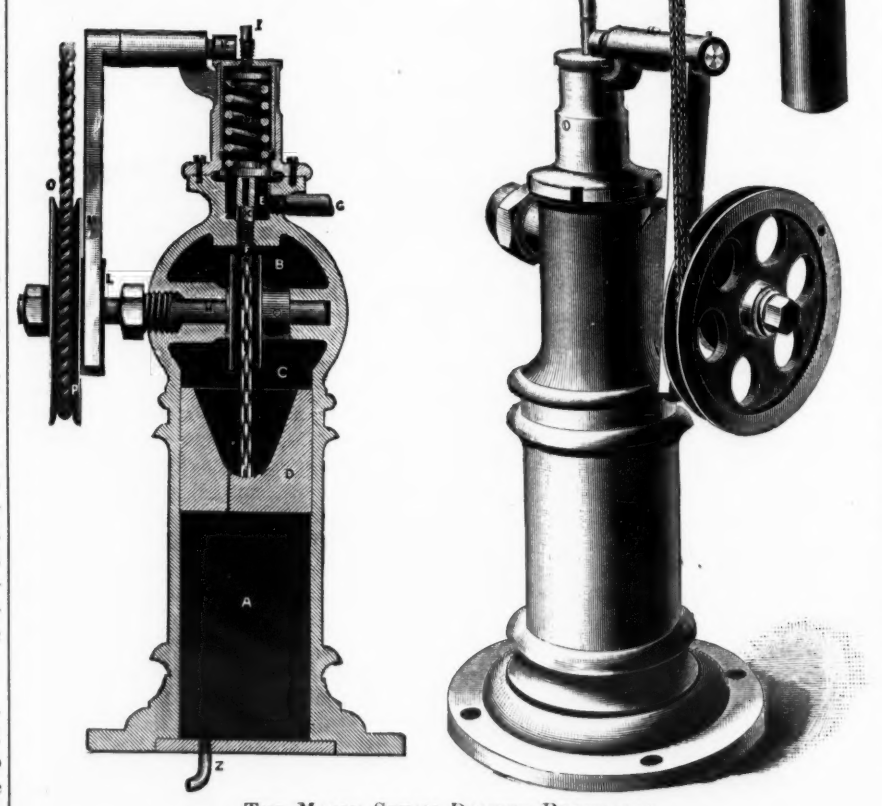
There seems to be nothing in this country that English syndicates are not in the market to buy. The clothes we wear, the matches we use, the tobacco we smoke—in fact, about all we use is to come to us through the intervention of foreign capital. This indicates that the profits of manufacture must be good here, or that European capitalists believe in the stability of the government, or both. In the end we have no doubt that some of these promising schemes will rather suddenly collapse.

Early Engineering Reminiscences.

BY GEORGE ESCOL SELLERS.

THIRTY-EIGHTH PAPER.

My residing in Cincinnati during the incipient stage of the invention as well as the after construction of the first practical steam fire engine being known to those who are still living of my early mechanical associates, and particularly those of them who take an interest in tracing the progressive steps of invention, has brought to me many inquiries coupled with earnest solicitations for me to put on record what I recollect concerning that important invention. I have felt a delicacy in doing so, as they do not fully agree with the generally received belief as to its paternity, and to whom is due the credit for that successful demonstration that has led to such great practical results, and I should not now do so through the columns of the AMERICAN MACHINIST, had I not, in two recent visits to Cincinnati, found evideuce, part of which is documentary, confirming me in my recollections.



THE MASON STEAM DAMPER REGULATOR.

It is no easy task to trace with accuracy the evolution of an invention, no matter how important it may be, after the active participants have passed away; I would instance the long unsettled controversies as to the claims or merits of Fitch, Fulton and Evans in our own country, and those of Hulls, Symington and even Savery in the old country (it being claimed for the latter, that he anticipated propelling vessels by steam), to whom the meed for the grand and successful application of steam to navigation belongs.

To understand how it was possible for Cincinnati to have achieved the credit and honor of the first practical steam fire engine, it will be well to glance at the organization of its fire department at that time, which, though called independent or volunteer, was not so in the same sense as in the eastern cities. At the time I removed to Cincinnati, in the fall of 1841, there were only two really independent organizations, that is, owning their own apparatus. The buildings and apparatus of all other fire companies being the property of the city, the organizations only having the use and control, without any ownership in them. The apparatus being kept in repair at the city shops, under the direction of the chief of the fire department, or, as called, city fire engineer, and at the expense of the city.

The two really independent companies I have referred to were composed of some of the oldest and best citizens, such men as Judge Burnett, Nicholas Longworth, I. P. Foote, George Graham, Wm. Green, and many others I could name—men of energy and enterprise that Cincinnati owed her marvelous advance and prosperity to. Although I never became connected in any way with any of the fire companies, I was socially on most intimate terms with many members. My boyhood acquaintance with Father Edwin Collins was renewed, and our intimacy continued until his death; Father Collins was a member of the Franklin Fire Company, and later of the independent "Rovers," the silk stocking company, a most enthusiastic and never-tiring fireman. He stood in Cincinnati as much the "par excellence" of firemen, as Philip Garrett did to Philadelphia, previous to that period. My business connections brought me into daily communication with Miles Greenwood, who was also an enthusiastic fireman. From frequent conversations with these gentlemen, but mainly with Messrs. Graham, Foote, Collins and Greenwood, I learned that there was a move on the part of members of the Independents, some of whom were growing old and had been a long time in active service, to induce the city to assume the entire ownership, and adopt a pay system of regular firemen. The Independents being willing to surrender and donate to the city all their valuable apparatus and appliances that had cost them many thousand dollars, if the city would accept, and form such an organization as they by their long experience would suggest. The object of this was to secure certainty and uniformity of action in case of fires, and lead to the most desirable end of checking that rivalry among the companies, who had no direct interest, such as ownership in their apparatus, and were not responsible, and therefore so reckless in their contests for supremacy. These contests sometimes led to broken heads, or, what was of more consequence to the city, such as cut hose or broken apparatus, inasmuch as the city maintained the shops for making hose, repairing and maintaining the apparatus.

The bringing about the desired change was a slow process, but during the years of its progress I had frequent conversations with these progressive thinkers, who had taken great interest in the reports, as they came to America, of the experiments in London of John Ericsson in applying steam power to fire engine pumps as early as 1830, and his failure to make it a practical success, notwithstanding which, they had faith that plans would be devised to make it successful, and were looking anxiously for the results of experiments Mr. Ericsson was then making in New York (he having removed to America). As near as I can by recollection fix the date, it was 1843 or '44, when, in company with Chas. Copeland, Mr. Bogardus and Col. Hoe, of printing press celebrity, I went to see and witnessed the performance of Captain Ericsson's steam fire engine. We met there Mr. Peter Cooper, Mr. Stillman, of the Novelty, Mr. Kembal, of the West Point Works, and a number of prominent civil and mechanical engineers. It was there that I had the pleasure of an introduction to that extraordinary man, Ericsson. It was the first time I had seen him, and I confess to having been more interested in his earnestness, and in watching his changes of expression during the trial, than in the machine itself. There was much delay in getting up steam, but when once up, the pump was worked powerfully and effectively, until a break in the hose obliged it to be stopped; this I have cause to remember, as I was one of the unfortunates well drenched, and left before it was remedied.

It is with the utmost confidence that I state that many of the progressive Cincinnatians that I have referred to had become convinced that the time had come that a more certain and untiring motor for fire engine pumps than man-power must be found, and they looked to steam as that motor, and they realized that the important question to be solved was the quick and steady generation of steam within an apparatus not too cumbersome and heavy for quick transportation.

They were very particular in their inquiries as to my recollection of what Jabob Perkins had done in that direction, and also of another effort I had spoken of. Perkins' experiments were not made during the time my father was connected with him, but after he had withdrawn, and Dr. Thomas P. Jones had taken his place. Dr. Jones is well known to the mechanical world as once Commissioner of Patents, and afterwards as agent for procuring patents, with office in Washington; during the latter part of his life Charles Keller was associated with him. Although I was not over 14 years of age at the time of Perkins' experiments, I was in the shops almost as frequently as during my father's connection with them, for at that time Dr. Jones was delivering a course of lectures at which I acted as his boy assistant with his illustrative experiments; and I took great interest in the experimental trials Perkins was then making with the Hawkins steam generator, the invention of blind Hawkins, who was present at all the trials. In this generator Perkins believed, and so expressed himself, would be found all the properties requisite to the successful application of steam to fire engine pumps—lightness of furnace and generator—by the high pressure of steam he contemplated using, reduction in size of steam cylinder, and consequently reduction in weight. The first experiment that I recollect was injecting into highly heated tubes, just sufficient water to furnish, as it flashed into steam, the amount required under high pressure for each stroke of the piston. This was not exactly on the principle that Hawkins claimed to be working under—that was that in strong tubes, with a heavy loaded safety-valve, water could be heated to any required temperature, and, if allowed to escape, would flash into steam with an expansive force due to its temperature, that water being practically non-compressible, by injecting into a tube already full the loaded valve would lift, and a like volume of water escape and flash into steam and drive the piston of the engine. I have given this description as near as I can recollect in the words of the old blind inventor. The change was made, and many more experiments tried. With the difficulties and troubles encountered with copper steam pipes and the substitution of gun barrels for them, leaky joints, burning out of steam packing by the superheated steam—we have nothing now to do—their name was Legion. But such patience and perseverance in overcoming difficulties as was shown by both Perkins and Hawkins is rarely to be met with. I have no recollection that the results of these experiments ever took the practical shape of a fire engine, though I have a vivid recollection of having many times heard Perkins, in his quick, impulsive manner, exclaim: "We shall see; time proves all things; steam never tires; the time will come that all fire engine pumps will be driven by steam"; he would then reiterate, "We shall see; time proves all things."

I would remark, *en passant*, that it was these experiments with blind Hawkins' generator that laid the foundation for one of the greatest excitements of the mechanical world, running from about 1822 into the thirties. I allude to the reports from England of the wonderful economic results resulting from the use of Perkins' steam generator, and his safety high-pressure engine using steam from 800 to 1,000 pounds to the square inch, and also the steam gun, throwing a constant stream of bullets.

It was about 1822 or 1823 that the firm of Sellers & Pennock, of which my father was a member, were engaged in building their horizontal double-acting pump, arranged with suction pipe to draw water from cisterns, and also with reels to carry their own hose, under the name of Hydraulions. My elder brother Charles had charge of the erecting shop, and I, as a boy, did the drafting, or such of it as was done in those days when chalk diagrams, rude pencil sketches, or forms whittled out of soft pine answered. At about this time Mr. Samuel Morey came from somewhere East, I think Hartford, but of that I am not certain; he brought with him to Sellers & Pennock's shops a small working explosive gas or vacuum engine, in which he used the gas or vapor from turpentine, alcohol, or any substance that, with a low degree of heat, would evolve inflammable vapor, which vapor, combined with atmospheric air, was ignited within the cylinder; part of the flame from the explosion escaped through quick-closing flap valves, leaving just such a vacuum in the cylinder as was left in the fire-cup as applied by the surgeons of those days. Mr. Morey's object in bringing his engine to their shops was to show its operation, and, if possible, induce the firm to construct a fire engine, using his plan of engine as the motor. To show its performance he had it placed on a small boat on the Schuylkill; it performed well for such a crudely built engine as it was. I do not recollect that any device or plan was shown for its application to the fire engine pump—it was simply two vertical single-stroke vacuum cylinders. I was present at a conversation Mr. Morey had with my father, in which he claimed lightness of machinery. His vacuum cylinder was, if I recollect right, about 10″ diameter, and was made out of 40 pounds sheet copper, no more strength being required than to resist the atmospheric pressure. His vapor generator was made of sheet tin, with a simple argand burner on a common oil lamp for heat. He claimed that he could start his engine in less than three minutes after lighting the lamp.

I have referred to Ericsson in London, Perkins and Morey in America, not to record in absolute detail what they did, for, in a lapse of over sixty years, much has been forgotten, but I want to show that the minds of many were in the direction of a never-tiring motor for fire engine pumps, for all knew the great difficulty of keeping the ordinary fire engine fully manned and effectually worked when most needed—in the case of extensive fires of long continuance, no matter how great the excitement or enthusiasm of the people and willingness to volunteer aid.

Mr. George Graham, though not a practical mechanic, had gone so far as to devise a system that he believed could be made successful. He proposed using an upright tubular boiler, the water in which was always to be kept slightly below the boiling point by tubular connection with a small auxiliary boiler which he called a store boiler, quick kindling and fuel in the fire-box ready to apply the match on the connection with the auxiliary being broken, and the engine started on its errand, drawn either by man or horse-power, steam being gotten up on the way, ready for immediate work on arrival at the fire. Thus far Mr. Graham's and Perkins' minds were in the same direction, of utilizing the time of transit, for the latter proposed keeping a slow but constant fire under his generating tubes, to be urged to quickness on transit, when a few strokes of the injecting hand pump would start the steam engine. Mr. Graham never tired of urging that an experiment should be made on the system he proposed.

Mr. John P. Foote was equally sanguine as to the Buchanan coil ultimately proving to be the steam generator that would solve the question as to the practicability of using steam as the motor for fire engine pumps. Some years previous Mr. Foote had witnessed and assisted in experiments made by Buchanan with the coil, and had fully reported the results in a Cincinnati daily paper that was extensively copied, and caused considerable excitement among steam engineers. Mr. Buchanan, the inventor, was of Lexington, Ky. I have been informed that he labored for many years unsuccessfully to have his generator adopted for steamboats and stationary engines. The principal feature of his coil was its increasing in size from the point where the water was injected to the delivery of the steam, to allow space for expansion of water and evolved steam, and, as the water became heated, an increased fire surface. Mr. Foote had so much to say about the merits of this peculiar coil steam generator, and his belief in its adaptability to steam fire engines, that Mr. Abel Shawk, who at that time was carrying on the manufacture of door locks, became sufficiently interested to treat with Mr. Buchanan, who had become greatly discouraged, for his patent rights, which resulted in Mr. Shawk's purchase of them and of a copper coil that was then out of use at a mill at Johnstown, ten or twelve miles from Richmond, Indiana; this coil had been made at Lawson's coppersmith shop in Cincinnati. When Mr. Abel Shawk became its owner he sent his brother-in-law, Mr. Stokes, who brought it to Cincinnati. This fact I have confirmed in a note from Mr. Theodore Stokes, who states that the coil was at the mill of two parties, the name of one was Letch, the other he does not remember. I am thus particular as to this coil generator, as it was the real starting point of the successful steam fire engine, and that Mr. Abel Shawk was the first person to back his faith by the expenditure of time and money. Mr. Shawk was the father of Miss Caroline, now Mrs. Brooks, sculptor in Florence, Italy, who became famous by her head of the sleeping Iolanthe, modeled in butter, which must be remembered by many of the crowds attracted to it as exhibited at the Centennial.

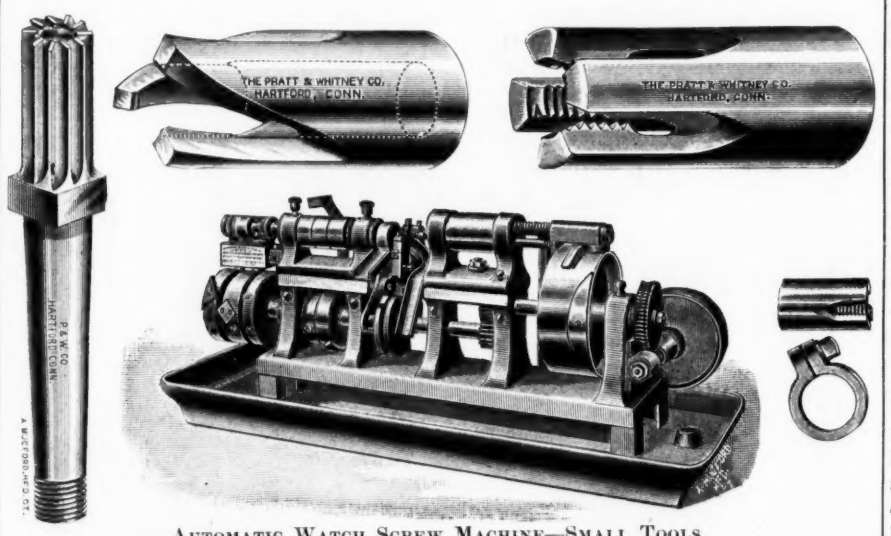
Mr. Shawk was a man of original thought, application and energy. I saw much of him about the time he became possessed of the coil, and witnessed several experiments in quick getting up steam. At one of these trials and tests, Mr. Jeffrey Seymour, Messrs. Graham, Calvin Fletcher, Father Collins, Miles Greenwood, Chas. Stetson, and others whom I cannot recall, were present, some of whom may yet be living, but all that I have named have passed away. At this test its application to fire engines was fully discussed, and all present united in a petition to council to give aid to Shawk to make a practical test on behalf of the fire department. As to the fate of that petition and after acts of the city council, I am indebted to Gen'l C. H. Sargent, who was at that time a member of one of the independent companies—the "Rovers"—also a member of the city council, and on the committee of the fire department, of which my impression is that he was chairman. On the recommendation of this committee, a motion was made "to appropriate one thousand dollars to aid *Abel Shawk* in making a practical test," which motion was lost by the emphatic "*I object*" of a member of council, who, in the role of economic reformer, had gained for himself, among the go-ahead community, the unenviable title of the "Great Obstructionist."

The resolution was finally amended on the motion of Mr. Sargent, giving *Abel Shawk* the use of the shops of the city fire department, and such material as was on hand, to aid him in the demonstration. Up to this time Shawk's name is the only one in connection with the steam fire engine that appears on the minutes of the council.

I must now be permitted a digression before continuing my recollection of the experiments.

In 1841 and 1842, when my brother and myself were erecting our lead pipe works, the hydraulic press and other heavy machinery was being constructed at the foundry and machine shop of Anthony Harkness. I there became acquainted and intimate with his foreman, Mr. A. B. Latta, a progressive, skillful and inventive mechanic, who had about that time completed and put in operation what was considered a master-piece of mechanism—a planing machine large enough to face, for side pipes of the largest size steamboat cylinders then constructed, also valve faces of blowing cylinders, for iron furnaces—and was then commencing the construction of Harkness' first locomotive.

At the time of the resolution giving Shawk the use of the shop and materials, Mr. Latta had left the employ of Harkness, and had established a shop for repairs, and making machinists' tools and small steam engines. I have the impression that in this his crippled brother, Eben Latta, was associated with him, and a younger brother, Finley, was a hand working in the shop, who afterwards became foreman of the city repair shop, and for a time engineer of the second steam fire engine built—the "Citizens' gift." Mr. Eben Latta was a man deserving more than a passing notice. Notwithstanding his crippled condition, having no use whatever of his lower limbs, he made himself master of any subject he took up, and, as a sound mechanic he had few superiors. He seemed to be idolized by his brother, who would carry him to his seat in the shop, where he would remain from morning until night, with his books, papers and draft-board. His memory was wonderful; the most trifling details were never forgotten; he was a perfect encyclopedia, and I have spent many pleasant and profitable hours in conversation with him; in fact, I used to look on his as the chief brains of the establishment.



AUTOMATIC WATCH SCREW MACHINE—SMALL TOOLS.

Automatic Watch Screw Machine—Screw Machine Tools.

We give, on this page, an illustration of an automatic watch screw machine, made by the Pratt & Whitney Co., Hartford, Conn., together with some small tools used chiefly in the production of screws, though of larger sizes than the machine shown is intended for, it being only for screws for watches, and other small screws or turned work of a similar nature and size.

The tools are held in spindles, which are guided by their bearings in a turret which revolves in a vertical plane, and the axis of which is parallel to the spindles themselves, and also to the head spindle, each spindle with its tool being fed forward and back automatically while in position to do its work. All motions of the tools, as well as those for feeding the wire, and for releasing and tightening it in the chuck, are entirely automatic, being controlled by a series of cams fixed on a shaft running lengthwise through the lower part of the frame.

This shaft has two different rates of motion, the slower one being used when the tools are cutting, the faster motion when the various movements preparatory to cutting are being made. The change of motion is affected by the automatic shifting of the belt, which drives the cam shaft from one pulley to the other, one of these pulleys driving the shaft direct, the other through the medium of a sun and planet motion, or epicyclic train, giving slow motion. By setting the cams provided for this purpose, these changes of motion can be made to take

place at any desired point to suit the nature of the work.

The machine is built with two to four spindles in the revolving head, and with one spindle in the non-revolving head.

The spindles and bearings are of hardened and ground steel of the standard shape used in watch tool lathes and other machinery of the same character.

The threading dies shown are such as have for some time been in use in the shops of the company, and furnished with screw machines when desired, but are now kept in stock for the market. They are so formed as to permit of adjustment for size within certain limits, which is effected by means of a small clamp collar which encircles the outer end of the die.

The hollow mill shown is the form adopted for removing stock, especially preceding the running on of the die.

The end mill shown is a new form adopted by the company, in which the usual flat at the end of the shank is replaced by a screw thread, which draws the taper shank to a firm bearing, the cutter being loosened for removal from the socket by means of a wrench instead of a hammer and key. Left-hand cutters, of course, have left-hand threads.

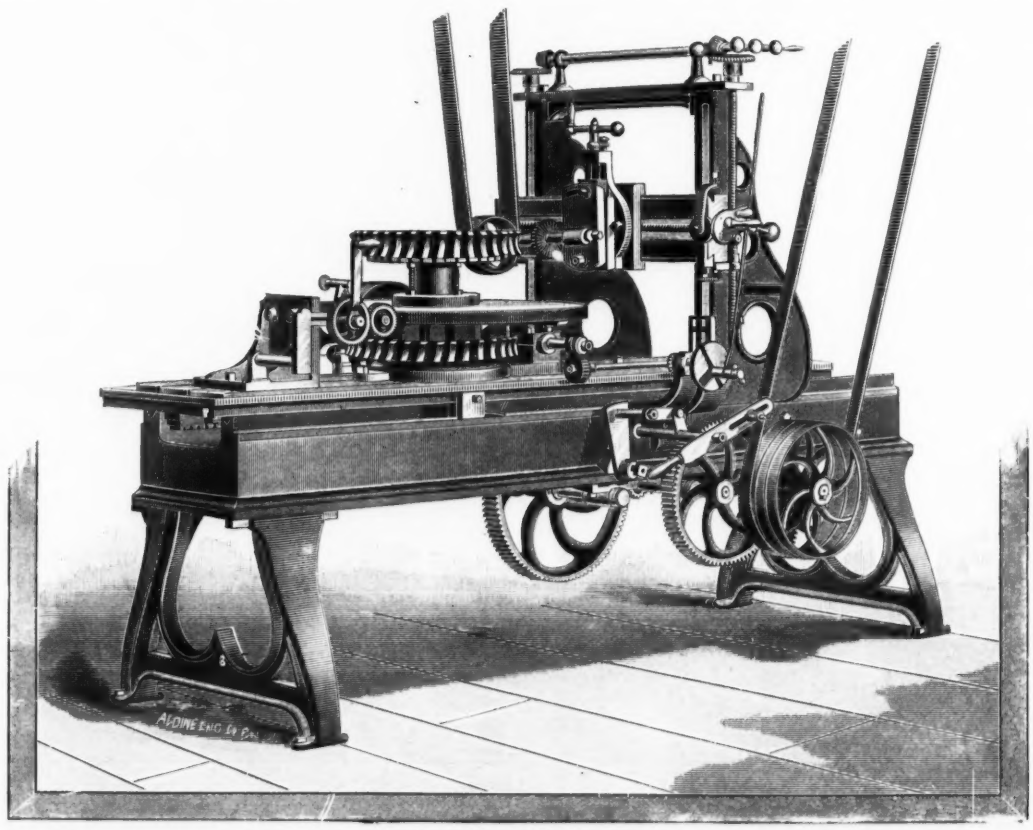
Hand-Punching Machine.

We illustrate herewith a machine which is especially adapted to light sheet metal work. It will punch a $\frac{1}{4}''$ hole in $\frac{1}{2}''$ iron or its equivalent. The depth of jaw is 15″ and machine will punch anywhere in a sheet 30″ or less in width. In addition to the regular sheet metal work, it can be used for punching holes in pipes $4\frac{1}{2}''$ or larger in diameter, 8″ or less from end of pipe. The plunger that holds the punch is operated by an eccentric, which in turn is worked by a hand lever. This lever can be worked either at the front or rear. The machine is provided with a stripper that can be adjusted very accurately, also with gauges and with one each $\frac{1}{8}''$, $\frac{5}{16}''$ and $\frac{1}{4}''$ punches and dies. It is made by the New Doty Mfg. Co., Janesville, Wis.

Turning, Boring and Gear-Cutting Attachment for Planers.

The cut accompanying this is intended to show the construction of an attachment for a planer, the purpose of which is to bore and turn pulleys up to a moderate diameter and width of face, or to cut spur gears or worm wheels.

The large worm gear underneath is the one by which the device is driven, a worm working into it, which is in turn driven by means of a four-stepped cone pulley, at the back side of the planer. This worm shaft extends through to the front side of the machine, and at its extreme end is a small worm, from which, by suitable mechanism, motion is imparted to a slotted disk; from which, by means of the usual rod, motion is imparted to the feed screws of the planer. Above the main driving gear is a plate, the edge of which is cut with worm teeth, and by this, in connection with suitable change gears and a hand crank, teeth may be indexed for cutting gears. When cutting gears, the regular clapper-box is removed, and the stand for cutter spindle substituted for it. The vertical feed of the planer is used in gear cutting, and for turning or boring pulleys, and pulleys may be either straight or crowned on the face.



ATTACHMENT FOR PLANERS.

The attachment can be applied in a few minutes, and will turn and bore pulleys up to 40″ diameter on a planer having a 4′ platen and a distance of 22″ between the uprights; the width of face being limited only by the traverse of the vertical feed.

It is made with or without the gear-cutting attachment, by the Union Machine Co., Providence, R. I.

Exposition Reflections.

BY C. W. CRAWFORD.

II.

The great Exposition has been a success in more ways than one, and the overwhelming patronage of it betokens the increasing popularity of these international entertainments. The success of it was no doubt enhanced by the superior attractions of the French capital, and, not withstanding the apparent reluctance of some of the French exhibitors to communicate inside facts, and the difficulties of a strange language, Americans have had abundant opportunity to profit by the great show.

HAND PUNCHING MACHINE.

Aside from the circumstance that European machinists use more iron than we do, they are up to the front in workmanship and the use of tools, and their work cannot be excelled, except in the matter of design. While many of the separate parts of their machines are neat and simple enough *per se*, they lack, frequently, the aggregate simplicity and directness of American machines. In time this discrepancy will disappear, and American superiority will become ancient history. The extraordinary use of brains manifest in this Exposition indicates this condition, and the cheapness of their labor compared to ours may aid them in bringing about this change, unless our forthcoming Exposition shall demonstrate the contrary; we shall see.

The extensive use of tile roofs in all the towns near Paris indicates an important institute for our present wooden roofs, and the fact of our having plenty of the raw material for tiles is pleasantly suggestive of increased grist for the machine shops in the future.

A thousand other things can be made of clay, that are now made of wood, and the item of fence posts alone will make work enough for all the idle shops in the country.

The large display of electrical machinery from the various countries indicates a great scramble for theoretical perfection, regardless of mechanical principles, and provokes the opinion that, notwithstanding the electricians have produced some elegant machines of very high efficiency, they have made no provision for repairs, and about the first thing these machines need is repairs. The armatures, of whatever construction, are usually so compact, and the coils wound so close together, or overlapping each other, that it is difficult to locate a burnt spot, or to get at it in a reasonable time or at reasonable cost. What seems to be most wanted now is a machine made in interchangeable parts—coils, cores, commutators, and what not—that can be kept in stock and quickly adjusted, in an emergency, by any intelligent engineer. Until this is done, electric lighting may be considered a meager success, financially. The Exposition has not developed any improvement in this direction. There is no condition involved in the design of a dynamo that precludes the making of it in interchangeable sections, and the advantages accruing from such a plan would be very great. The dread of a burn-out, and the time required to get going again after such an accident, would be reduced to a minimum. The enormous expense of replacing or repairing the present style of armature would make all the difference between a profit and the reverse in the operation of it, and the amount might as well go into the light company's drawer, as that of the electric company.

The gaudiest view in the Exposition was that to be had from the balcony, at a point near the great blowing engine of the Société Cockerell, where four pairs of the largest engines in the Exhibition, ranging from 30″ to 60″ cylinders, could be seen, together with the blowing engine, all running at the same time, within a radius of a hundred feet. This was a view never before equalled.

The popular idea of the French Exposition, here, seems to hinge on the Eiffel tower, that being considered the principal feature of it; hence the many propositions to build towers for our big show in 1892. If we are to have a tower, I would suggest that it be composed of four leaning towers joined together at the top by arches into an entablature, upon which shall be erected a single column surmounted by a spread eagle or other suitable device. The four towers should present the four (nearly) extinct American races—the Mound-builders, the Incas, the Aztecs, and the Indians, and the superstructure to represent in four sections the four centuries of American history and progress, by means of bas reliefs after the fashion of the Column Vendome. The height should be commensurate with the present dignity of America, and a statue of Columbus should occupy the center.

An English Cotton Mill.

The North End Spinning Company, Bolton, with a share capital of £100,000, has, we understand, been successfully formed, and steps are being taken for the early commencement of the building operations. The land is freehold, and contains 15,116 square yards, the sum of £2,120 having been contracted to be paid for the purchase of the estate. The site is within easy access of Halliwell and Astley Bridge Goods Stations. The new building will be five stories high, and will contain 72,000 spindles, the materials used being brick and stone facings. The arrangements of the mill, so far as the machinery is concerned, will be on somewhat new lines, which are considered to be a distinct advance on any mill that has yet been erected. For some time there has been a great partiality amongst builders, etc., for as much window space as possible; but this seems to be a questionable advantage, many of the most experienced cotton spinners looking upon too much window space as a disadvantage, inasmuch as it exercises, at certain seasons, a cool effect on the atmosphere of the mill, and consequently necessitates the introduction of considerably more steam. Without introducing excessive window space, sufficient light will be obtained for the new mill for all purposes of spinning. It was at first suggested by the promoters that iron mullions should be adopted for the windows, but this idea was overruled, such mullions being shown to be unnecessary, if not undesirable. The mill will be 324 feet long and 181 feet wide. On the ground floor there will be the card room, scutching room and warehouse, on the whole of one side is a ground-story shed, and at one end a two-story shed. The first floor will be used for spinning, cotton mixing and warehouse, whilst the remaining rooms will be devoted principally to spinning purposes. There will be a boiler house capable of holding four boilers, and an engine house containing one large engine for the mill and one to work the dynamo, it being contemplated to have the mill lighted by electricity. There is a basement under half the mill. Concrete and iron will be used in its construction, and, as an additional precaution against fire, in every room sprinklers will be fitted up. The mill will front Blackburn road and Cardwell street. There are two old reservoirs on the site, and they will be joined together and otherwise enlarged so as to contain a million and a half gallons of water. When completed the mill will present a handsome appearance, the design being of a very pleasing description. The machinery will comprise all the latest improvements, rope driving power being substituted for the belting driving so much in vogue in older mills. The contracts for the engines and boilers have not yet been let. It is expected that the mill will be in working order in ten months from the present time.—*Cotton Factory Times.*

Practical Drawing.

BY J. G. A. MEYER.

NINETY-SECOND PAPER—CONES.

650. *Definitions.*—A cone is a solid generated by the revolution of a right-angled triangle around one of its sides adjacent to the right angle. Thus turning the right-angled triangle $v\ d_3\ a_3$, Fig. 524*a*, about the side $v\ d_3$ as an axis, it will generate the cone. The curved surface generated by the hypothenuse $v\ a_3$ is the convex surface of the cone; the line $v\ d_3$ is the axis of the cone; the point v is the vertex of the cone; and the circle generated by the side $a_3\ d_3$ is the base of the cone; the slant height is the distance from the vertex to any point in the circumference of the base; and the altitude of the cone is the perpendicular distance from the vertex to the plane of the base.

651. Any line of the convex surface, corresponding to some position of the line $v\ a_3$ which generates the convex surface, is called an *element* of the surface. From the foregoing definition it will be perceived that an element of a conical surface cannot be anything else than a straight line passing through the vertex, and lying on the surface of the cone; or we may say that a straight line drawn on the surface, terminating in the vertex and in the circuference of the base, represents an element. The elements are all equal, and any one is equal to the slant height; the axis is equal to the altitude.

652. The frustum of a cone is a portion of the cone intercepted between the base and a plane parallel to the base. For instance, let $v\ a_3\ b_3$, Fig. 524*a*, represent the vertical projection of a cone, and $a\ b$ a plane parallel to the base $a_3\ b_3$, then the shaded portion, included between the plane $a\ b$ and the base $a_3\ b_3$ is called a frustum of a cone. Its altitude is $d\ d_3$, and its slant height is $a\ a_3$.

653. A *truncated cone* is that portion of a cone intercepted between the base and a plane not parallel to the base. Thus, in Fig. 526*a* the shaded portion included between the base $a\ b$ and the plane $1e\ 6e$ is called a truncated cone.

The following remarks will relate only to cones whose axes are perpendicular to the bases.

654. To represent a cone completely, we must show two projections of it; one of these projections will always be a triangle; and the other will be a circle whose diameter is equal to the diameter of the base. In Fig. 524*a* the triangle $v\ a_3\ b_3$ is the vertical projection of a cone; the lines $v\ a_3$ and $v\ b_3$ represent elements which appear to be furthest away from the axis. The circle $a_1\ b_9\ c_{13}\ d_5$ in Fig. 524 is the horizontal projection or plan of the cone. Here again we notice the necessity of giving at least two views of an object, so as to enable us to present correctly our ideas of form. For instance, the elevation alone does not indicate what kind of an object is meant; it may represent a wedge, a pyramid, or some other object whose vertical projection is a triangle; so also the plan alone does not indicate whether a cone or a cylinder is meant; but the two views or projections as here given leave no doubt as to the form of the object, and indicate plainly that the solid is a cone.

It is also important to notice that the center v_2, which represents the horizontal projection of the vertex (Fig. 524) and the point v (Fig. 524*a*), which represents the vertical projection of the vertex, must lie in one vertical line, otherwise too much labor will be involved in finding any required section.

655. From the foregoing remarks it must not be understood that, in all working drawings, cones must always be represented by triangles in an elevation and by circles in a plan; indeed, these conditions are often reversed; but in geometry it is customary to represent a cone as we have here shown it.

656. The methods for finding the sections of cones, and also for finding the developments of their convex surfaces, may be made to appear very simple if we consider the cone to be a pyramid having a very great number of lateral faces. Looking at a cone in this light we can form a clearer conception of the methods involved, and the principles upon which these methods are based, will be precisely the same as those given in connection with finding the sections and developments of pyramids. Hence if the articles treating on pyramids have been studied, and are thoroughly understood, there will not be any difficulty in finding any section of a cone, or the development of any portion of a cone.

We shall now give the methods for finding the developments of the convex surface of the cone, and any portion of the same, also methods for finding some of the principal sections of the cone. These will be given very briefly, and it will be advantageous for the student to compare these methods with those for finding the developments of similar portions of pyramids, and sections of pyramids, as explained in previous articles.

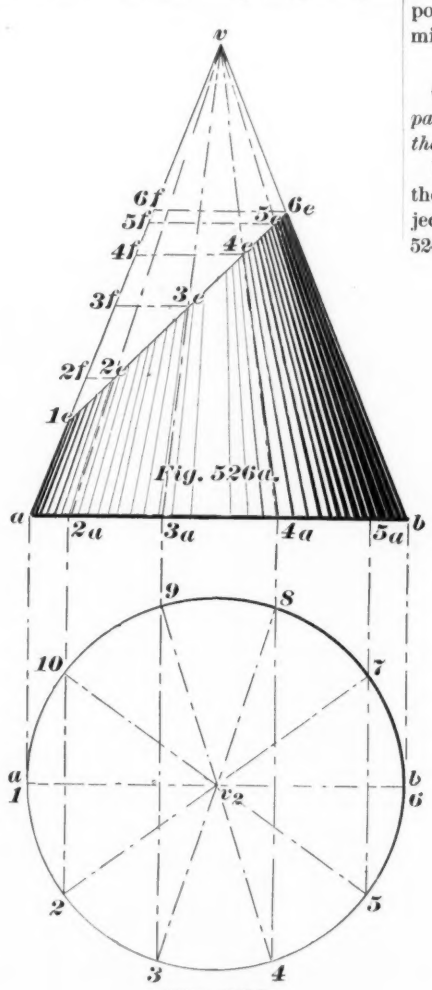


Fig. 526.

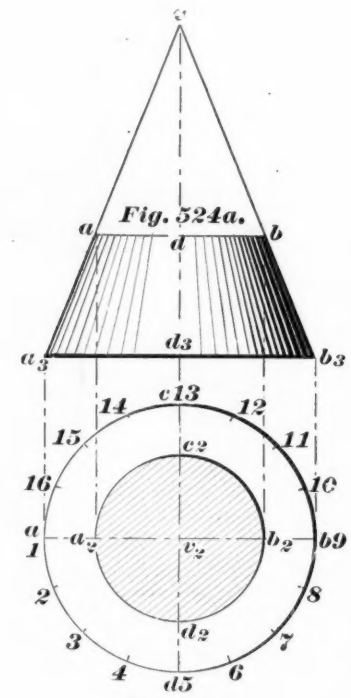


Fig. 524.

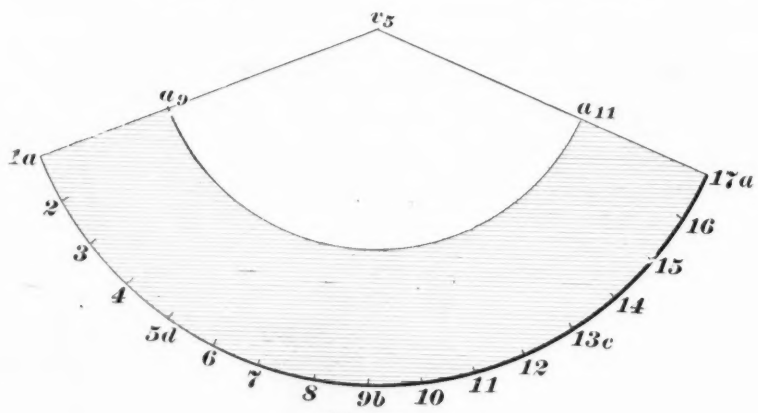


Fig. 525.

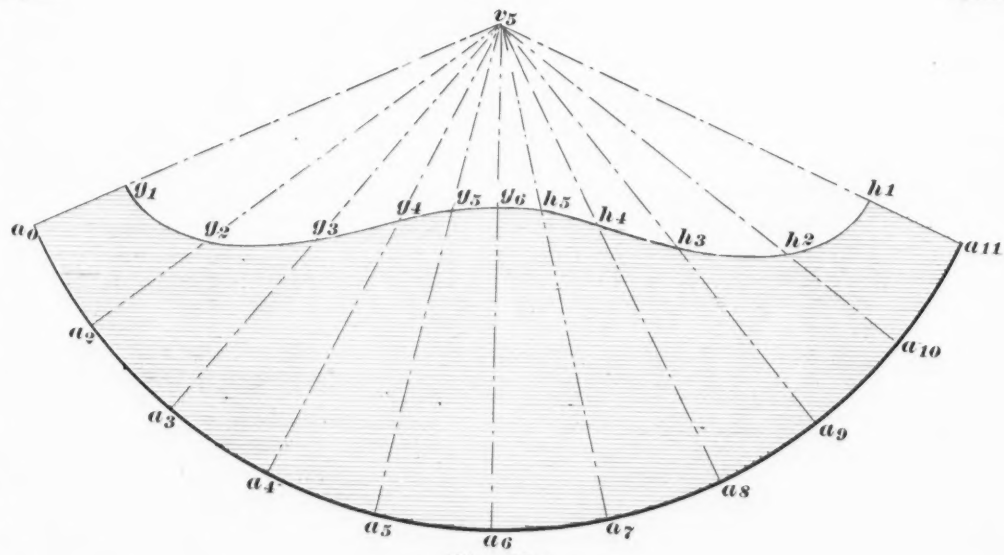


Fig. 527.

Problem 109.

657. *To find the section of a cone made by passing through it a plane perpendicular to the axis.*

Let $v\ a_3\ b_3$ (Fig. 524*a*) be the vertical, and the circle $a_1\ b_9\ c_{13}\ d_5$ be the horizontal projection of a cone, and let the line $a\ b$ (Fig. 524*a*) be a given cutting plane, parallel to the base; it is required to find the section. Draw in Fig. 524 the horizontal diameter $a_1\ b_9$. Through the point a (Fig. 524*a*) in which the line $a\ b$ intersects the line $v\ a_3$, draw a vertical line cutting the diameter $a_1\ b_9$ in the point a_2; from the center v_2, and with a radius equal to $v_2\ a_2$, describe a circle; this circle will be the required section.

Whenever the cutting plane is parallel to the base of a cone and the base is a circle, the section will also be a circle, and the diameter of the section will be equal to the length of the line which represents the cutting plane; thus, in the case before us, the diameter of the section is equal to the line $a\ b$. If the base is an ellipse, the section will also be an ellipse.

Problem 110.

658. *To find the development of the convex surface of a cone; also that of a frustum of a cone.*

Let Figs. 524*a* and 524 be the vertical and horizontal projections of the cone; it is required to find first the development of the convex surface of the cone.

Divide the circumference $a_1\ b_9\ c_{13}\ d_5$ (Fig. 524) into any number of equal parts; we have divided it into sixteen. From any point v_5 (Fig. 525) as a center and with a radius equal to $v\ a_3$ (Fig. 524*a*), describe an arc $1a\ 9b\ 17a$. Through the point v_5 draw any straight line $v_5\ 1a$ cutting the arc just drawn in the point $1a$; commencing from this point lay off in succession on the arc $1a\ 9b\ 17a$ sixteen equal parts each equal to one of the parts on the circumference $a_1\ b_9\ c_{13}\ d_5$, and thus obtain the length of the arc; through the point $17a$ draw a straight line to v_5. The surface bounded by the straight lines $v_5\ 1a$, $v_5\ 17a$, and the arc $1a\ 9b\ 17a$, or, in short, the sector $v_5\ 1a\ 17a$, will be the development of the convex surface of the cone.

In laying off the parts on the arc $1a\ 9b\ 17a$, it is customary among practical men to set a pair of dividers to one of the divisions on the circle in Fig. 524, and then step off the parts on the arc $1a\ 9b\ 17a$. The length of the arc $1a\ 9b\ 17a$ found in this manner will be somewhat short, for the same reasons as given in Arts. 417, 418 (Forty-sixth paper). The length of the arc $1a\ 9b\ 17a$ should be exactly equal to 3.1416 times the diameter $a_1\ b_9$; but for practical purposes we can generally obtain results sufficiently correct by dividing the circumference $a_1\ b_9\ c_{13}\ d_5$ into a great number of equal parts—the greater the number the more correct will be the results—and then laying off these parts on the arc $1a\ 9b\ 17a$, as explained.

659. *Second.*—Let the shaded portion $a\ b\ a_3\ b_3$ (Fig. 524*a*) be the vertical projection of the frustum of a cone; its horizontal projection consists of the two circles $a_1\ b_9\ c_{13}\ d_5$, and $a_2\ b_2\ c_2\ d_2$; it is required to find the development of the convex surface of the frustum of the cone. Prolong the lines $a_3\ a$ and $b_3\ b$ so as to meet in the point v, and thus obtain the projection of a cone of which the given frustum is a part. Find the development of whole convex surface, and thus obtain the sector $v_5\ 1a\ 17a$ in Fig. 525. From the center v_5, and with a radius equal to $v\ a$ (Fig. 524*a*) describe an arc terminating in the points a_9 and a_{11} on the radii $v_5\ 1a$ and $v_5\ 17a$; the shaded portion lying between the arcs $a_9\ a_{11}$ and $1a\ 9b\ 17a$ will be the required development.

Problem 111.

660. *To find the development of a truncated cone.*

Let the shaded portion $a\ b\ 1e\ 6e$ in Fig. 526*a* be the vertical projection of the truncated cone; it is required to find the development of its convex surface. To find this development we need the circle shown in Fig. 526, which is the horizontal projection of the lower base only; this figure is not a complete horizontal projection of the truncated cone, because it does show the upper base, but the upper base is not required for our purpose. Draw the horizontal diameter $a_1\ b_5$ (Fig. 526); commencing from a_1, divide the circumference into any number of equal parts, say ten, and through the points of division 2, 3, 4, etc., draw vertical lines cutting $a\ b$ (Fig. 526*a*) in the points $2a$, $3a$, $4a$, etc. Prolong the lines $a\ 1e$ and $b\ 6e$ so as to meet in the point v; and through this point v draw straight lines to the points $2a$, $3a$, $4a$, etc., cutting the line $1e\ 6e$ in the points $2e$, $3e$, $4e$, etc. Through these points draw horizontal lines cutting $v\ a$ in the points $2f$, $3f$, $4f$, etc.; this completes the preliminaries for finding the development.

Fig. 527. From any point v_5 as a center,

and with a radius equal to $v\ a$ (Fig. 526*a*), draw the arc $a_0\ a_6\ a_{11}$, and make its length equal to 3.1416 times the diameter $a_1\ b_6$ (Fig. 526). Divide this arc into the same number of equal parts as laid off on circle in Fig. 526, and through the points of division draw straight lines to the point v_5. Make $a_0\ g_1$ equal to $a\ 1e$ (Fig. 526*a*); $a_2\ g_2$ equal to $a\ 2f$; $a_3\ g_3 = a\ 3f$; $a_4\ g_4 = a\ 4f$; $a_5\ g_5 = a\ 5f$; and $a_6\ g_6$ equal to $a\ 6f$; join the points g_1, g_2, g_3, g_4, g_5 and g_6 by a curve. In a similar way find the points h_5, h_4, h_3, etc., and join these points by a curve; the shaded surface included between the curve just found and the arc $a_0\ a_6\ a_{11}$ will be the development of the truncated cone.

The development on the left of the line $g_6\ a_6$ is exactly equal to that on the right of it, so that if we have a template for one-half of this development, we may use the same template for the other half. The correctness of this construction will be readily perceived. The lines $v\ 2a$, $v\ a_3$, etc. (Fig. 526*a*), are the vertical projections of elements of the convex surface, and the lines $v_2\ 2$, $v_2\ 3$, etc., (Fig. 526), are the horizontal projections of the same elements; the lines $v_5\ a_2$, $v_5\ a_3$ (Fig. 527) represent the position of these elements in the development of the surface. In Fig. 526*a* we see plainly those portions of the elements intercepted by the upper base $1e$ $6e$, and the base of the cone $a\ b$, and these portions or lengths must be laid off correctly in the development. The element $v\ a$ is parallel to the vertical plane of projection; we therefore see its true length, and also the true length of the portion $a\ 1e$ intercepted by the two bases; hence $a_0\ g_1$ in Fig. 527 must be made equal to $a\ 1e$. The element $v\ 2a$ Fig. 526*a* is not parallel to the vertical plane of projection, consequently we do not see its true length, nor the true length of the intercepted part $2a\ 2e$; to obtain the correct length of the latter we draw through $2e$ the horizontal line $2e\ 2f$, then the true length of $2a\ 2e$ is represented by $a\ 2f$, and therefore we make $a_2\ g_2$ (Fig. 527) equal to $a\ 2f$. Similar remarks apply to the other elements, and indicate the reason for drawing the horizontal lines through the points $2e$, $3e$, $4e$ and $5e$.

For the sake of simplicity we have divided the circle in Fig. 526 in comparatively few parts; for accurate work it should be divided into a greater number of equal parts.

Twenty-six Inch Drill.

The drill press illustrated on this page is a recent addition to the list of such machinery built by J. E. Snyder, Worcester, Mass.

It is of 26″ capacity, back-geared, with power feed, quick return, etc.

The cone pulleys are for a 2½″ belt, the largest step being 11″ diameter. Spindle is of crucible steel, with bearings 1⅞″ diameter. Vertical movement of head and spindle, 25″; automatic drilling capacity, 25″; vertical movement of arm and table, 19″. The machine will drill to the center of a 26″ circle the entire length of the column, and weighs 1,600 pounds.

TWENTY-SIX INCH DRILL.

Practical Details of Blacksmithing.

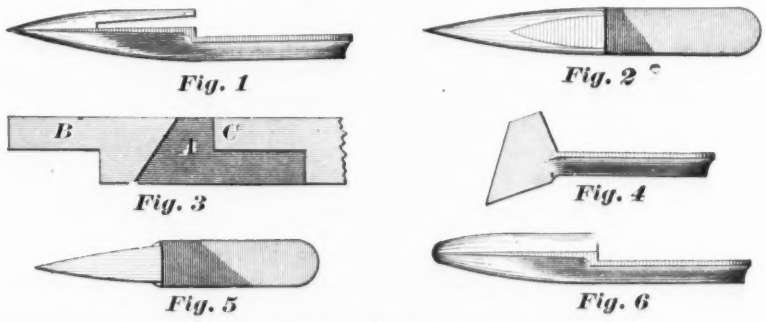
BY B. F. SPALDING.

REAPING MACHINE GUARDS—THE OLD STYLE OF FORGING GUARDS—MODERN METHODS—SAWING SLOTS—CASTING GUARDS OF SOFT STEEL.

There are three manufactories in a town in Ohio, which jointly put out not less than 60,000 reaping and mowing machines every year. Each machine has a cutter-bar, on which, at distances three inches apart, are set "guards" similar to that of which two views are shown in Figs. 1 and 2. The shortest of these bars takes 18 guards, so that, in this one manufacturing city, there are made yearly not less than a million of these pieces. As all reapers and mowers, in common use, have something similar, for the same purpose, the number of guards made annually in the United States, by the many manufactories engaged in this business, is perhaps as large as that of any other article which requires so much work, with the exception of railroad supplies, and horseshoes. They must be made very strong, so that careless operators may not break them by driving full tilt against stumps and stones.

Cutter-bar guards have been made in various ways. Some have been cast of malleable iron; some larger, of cast-iron, and from Hussy's first invention, the best have been made of wrought-iron. The knives which do the cutting are plates of sheet steel, triangular in form, ground to an edge on two sides, and slide back and forth through the slot, making a shearing cut against the edges on the lower sides of the slot. It will thus be seen that the guard has its share of cutting to do, as much as either side of any shears, and must, therefore, be made hard enough to keep its edges sharp. Those which have been made by the casting process have sometimes been provided with facings of steel, where required, or have had the edges hardened, more or less by various processes.

As was quite natural to the blacksmiths of those days, they forged the first that were made in such shape as to leave the slot ready made in the forging, because skilled machinists had not brought the resources of their trade to bear upon the process of sawing them out. It was soon found, however, that it was slow work to forge them, and bend over the upper leaf, leaving stock enough in the bend to draw out for a point, and inserting a thin mandrel to hammer the upper leaf down upon, and they were afterwards left solid, different methods being devised and used for sawing them out, until the machines now used were contrived and perfected by ingenious and skilled mechanics. By the use of these machines, one man is able to slot 2¼″ deep, through iron an inch thick, 1,200 per day, with absolute uniformity.



DETAILS OF BLACKSMITHING.

The necessity of having cutting edges on the lower side of the slot led to making the guards at one time in three pieces. The blacksmith took a bar of iron an inch square, and after tapering it off a little, laid a small piece of steel on the right place, and welded it down. He then laid a piece of iron over it, and welding all together, drew it down for the point. He had a die containing a suitable impression, into which he hammered the back part with a set hammer, and a top swage, which he set upon the point, and thus made the guards of a uniform size and shape. The steel was welded in, in the right place, so that when the slot was sawed, the lower side of the slot was steel, and the upper leaf iron. The work of sawing must have been hard on the saws, for the method of annealing was quite crude, and not such as to assure a proper degree of softness. After sawing, they were hardened by heating to a red heat, and cooling them in oil or water.

The idea was suggested after a while, that they might be made of some kind of iron which could be made hard enough for the purpose by case-hardening, immersing the whole thing in water, without making the back too brittle, and, experiment having demonstrated the feasibility of the idea, it was adopted, and they have since been made in accordance with it.

It was necessary to forge them carefully, to avoid getting cold shuts in the corners, and it was at first considered a big day's work to make fifty, but emulation among the workmen, and improvements in the methods, little kinks picked up from time to time, ran the number up to a hundred a day, for a man and his helper, and that was allowed to be a good day's work for a good blacksmith and a good helper. This was an average of 50 a day for each man. Even this was too slow, too laborious, and too expensive. The average now is about 300 per day to each man, and is made without the expenditure of one-quarter of the hard labor.

The manner in which this great saving of labor has been brought about has been by the application of steam-power to the purpose, by means of a well-devised system of properly constructed tools.

In order to convey a more definite idea of the work, it may be stated that the length of the point is 4½″, that of the back 3½″. The stock used is 1½″x⅝″. The first operation on the bar is to punch out a shape, shown in Fig. 3 at *A*. This leaves the end of the bar of the shape shown at *B*. This is then shoved up against a gauge, and the shape *A* is again punched out, and, as will be seen by examination of the cut, this leaves *B* of the same shape as *A*, and the end *C* being shoved to the gauge, the next stroke, and each successive stroke of the punch, makes two pieces of similar shape. These are the "blanks" for the guards.

They are now carried to a double furnace, attended by two heaters, in which, in lots of twenty-five on each side, they are heated to a welding heat. While one heater is handing his out to the roller, the other is loading his fire and raising the blanks to the proper heat. This avoids any cessation of the work of the rolls. They are handed, one at a time, to the breaking-down roll, which at one pass rolls out the back, in an impression which receives just the right amount of stock, the overplus appearing as a fin, which is chipped off on a hardy, and the piece is then handed to the point roller, in the shape shown in Fig. 4. The first pass through the point roll is to narrow up the point sidewise (see Fig. 5); the second takes it edgewise, when it has the blunt-ended shape shown in Fig. 6. These operations are repeated with some exercise of judgment on the part of the attendant two or three times, until it resembles Fig. 1, except that it has no slot, and is not straight. The point roller hands it to the drop-hammer man, who gives it two blows with a heavy drop, which fits it perfectly to the steel dies which give it the correct shape, and they are then thrown upon the floor, having been forged at one heat.

When cold, they are pressed through the trimming dies, at the punch, to remove the fin, and afterwards a low heat is taken on the tips to bring them to a fine point, with a light trip-hammer. They are then ready to be slotted out by the mills. In the machines used for this purpose in Springfield, Ohio, which have been perfected by such able mechanics as Jerome Fassler, and Charles A. Bauer, the cutters revolve to the right, and the 36 guards, which are fastened in groups of three in 12 separate vises, which are attachable to a rotary frame, revolve in a contrary direction. When a full revolution has been made the guards are taken out with the slot completed. The motion of the machine is not interrupted to insert the work, and each machine is attended by one man.

The holes are drilled by special drill presses, designed expressly for this work. The spindles are set at the right distance apart, and both holes are drilled at the same time. One man attends four presses, each of which has four spindles, drilling thus two gnards at once, and 1,500 per day. The machines work automatically, at such a speed as to keep him fully employed in putting in and taking out the work.

The whole system of operations is so well

designed and carried out, and is so complete in its working, that it presents a good illustration of the benefits derived from the division of work into distinct processes, the application of steam-power to the relief of manual labor, and to the increase of production; in short, of the advantage of modern methods of manufacture in comparison with the ancient.

Experiments are being made in casting the guards of soft steel. It is possible that, if pushed with determination and intelligence, they may, by the employment of some machinery, result successfully. It is better not to experiment at all, than to half try and fail, and deter others by needless lack of success. The project has the economical perfection of the present system to compete with. To succeed, it must produce as good a guard at no greater expense; or a better guard at a proportionate cost. There is no demand for a better guard, for no fault exists with the present. It outlasts all machines, survives disasters which ruin them, and remains good when they have become worthless. If the slots can be cored out with any kind of core, so well that they will be complete when they come from the mould, or only require buzzing out; and if the holes can be cast in, so that they can be cleaned out cheaper than they are now drilled; and if the moulding process is cheapened by machine moulding, with an adequate number of pieces in an easily handled flask, the necessary economy of manipulation may be secured; but there still remains the difficulty, which only great experience and uniform conditions can overcome, of getting the steel at every heat of such quality that it will bear hardening without becoming too brittle. The recent great reduction in the price of aluminum may have a bearing on the subject, for aluminum is the salvation of the mitis process.

LETTERS FROM PRACTICAL MEN.

Round or Square Chimneys?

Editor American Machinist:

In a recent discussion in your columns regarding the draught of chimneys having round and square horizontal sections respectively, there has been one point not brought out which I think is of importance, viz.: that sometimes, in square chimneys, there are supposed to be four minor downward draughts in the four corners that, of course, interfere somewhat with the major upward draught in the center, which is supposed to be of an approximately circular form, owing to its revolving in a spiral direction.

Whether this spiral action *always* takes place, or just how often, I do not know. That it may, under certain conditions, occur together with the downward eddies above referred to, is, I believe, well substantiated. Whether they take place to much extent in very tall chimneys is doubtful. I know, however, that in some cases the smoking of short house chimneys has been remedied by making the orifice at the top circular instead of square.

Probably there is no doubt but what Prof. Sweet is right in making the general statement that a round flue is better than a square one, providing they are of equal area.

OBERLIN SMITH.

Standard Tapers.

Editor American Machinist:

It is very possible, I suppose, that I may have an exaggerated idea of the difficulty involved in securing uniformity and interchangeability of lathe centers, but, at any rate, it seems quite certain that my ideas about it do not at all agree with some of your correspondents who have written on this subject.

I feel pretty certain that, if all lathe centers were fitted to the spindles as accurately as I was taught to fit them, it would at least be very difficult to get them so that they would interchange from one to the other and fit equally well. In the shop where I learned to fit them we had the best of reamers, made for the purpose by a well-known concern, and these reamers received the best of care; in fact, everything which it seemed possible to do was done to secure good and uniform results. Yet our method of fitting the centers showed conclusively that hardly two holes were made precisely alike even by the same reamer in the hands of the same workman. The final fitting of the centers was done by the aid of marking and a dead-smooth file, the marking consisting of the lightest possible coating of red lead; and no center was considered to be fitted until it showed a good bearing over its entire surface. Repeated trials showed that they would not interchange so that any center would fit any hole of a lot, but each center had to be marked for the hole to which it was fitted. Where centers are fitted as well as these were, I do not think it is practical to secure interchangeability, for the reason that it is scarcely possible to produce two holes so near alike that the difference between them is not easily shown by such a test.

Of course some will say it is not necessary that centers should be fitted in that manner, but nevertheless I think that a good deal of the trouble experienced with lathes not doing accurate work is to be found in imperfectly fitted centers, and if it is contended that anything short of actual contact of the center with the hole over its entire surface is good enough, then it might be instructive as well as interesting to try to come to a conclusion as to just what part of it should bear, and how much those parts which do not bear may be off without injury. My own opinion is that the centers of a good lathe intended to do good work should fit as well as I have indicated, and where they do, it will, I fear, be found a much more serious matter to secure interchangeability than some of your correspondents seem to think. Up to a certain standard of workmanship it is possible and practicable to secure interchangeability; beyond that point it is not practicable, even if possible. I fear that, in a shop where this difficulty is not fully recognized, and where it is thought to be easy to secure interchangeability, will be found the greatest and the quickest departure from any standard which may be set up.

And as for grinding centers wholesale in a fixture provided for the purpose, and keeping them ready to be put into headstock spindles and called true, it seems to me to be utter folly. I do not think either the fixture in which the grinding is done nor the lathe spindle can be made and kept true enough to do the best work in this way, where the truth of the finished work depends upon accurate lathe work, as much of it must, notwithstanding the grinding machine. I should like very much to know what proportion of all the lathes in use to-day would stand the following test: Supposing the center for the head stock spindle to be ground true in an independent fixture, the center put in place in the spindle, and a piece of work turned true near the live center, then loosen the dog and revolve the work half way round on the center, and see whether, when again driven by the dog, it will be precisely true. I venture to say that not one-tenth of the lathes in use will stand such a test, and when we come to consider the chances of the fixture being a little out of truth, so that the center itself may not be exactly true, I think the chances of getting the best possible work in that way would be slim indeed.

There are some very good center grinders made, by which, with a very little trouble, centers can be ground in place, and I think it will be found that that is the only way to get work as true as a good deal of the machinists' work should be, to be called first-class.

T. A. PANDIE.

Lathe Centers.

Editor American Machinist:

I have read with pleasure the articles on lathe centers. It is high time the lathe manufacturers got together and adopted a standard lathe center taper. Every lathe of a given size made in this country should have the same sized center hole.

Several years ago I bought four lathes of an old, reliable Eastern manufacturer. In a short time I got two more of the same size; these were all right in every respect, but the centers were smaller than those of the first four. In a short time we ordered four more, and specified that centers must be same as the first lot, and gave date of shipment. Well, you can imagine my disgust, when, on receiving the lathes, I found that the center holes were totally different from either of the previous shipments. It was my intention to have all these centers of one taper. They were used on the same class of work, and I wanted to carry centers in stock, and keep a certain class of fixtures to use interchangeably in the center hole, so I ordered them all of one maker. Now, when I give a hand a certain job, I am frequentiy confronted with the remark, "I can't do that; my lathe has the big hole, and the 'fixings' are fitted to the small hole."

It ought be the simplest thing in the world to have centers uniform. I told a large dealer in lathes the other day that, if he would begin and specify, when placing orders, that all his lathes must have a given taper and size of hole, that it would be but a very short time before he would get repeated orders for the same tools. This one question of uniformity of center hole would influence men to buy where they could be sure of getting the same thing. He thought so much of the suggestion that he said he would put it in practice at once.

Not many years ago every maker of drill presses had his own taper, some round, some square; no two makers alike, nor no two alike from the same maker. Now every manufacturer of these tools, with only one exception, puts in the twist drill taper, and the drills of any maker will fit them every time. If the lathemen will do the same thing, lathe centers will be manufactured and furnished at so much per dozen, with reducing sleeves to fit, so that, when necessary, a small center can be put in a big lathe—a very desirable thing sometimes—and a manufacturer will not have to lose valuable time fitting up broken centers, but when one breaks send to the office or tool-room for a new one that he can buy for one-tenth what it will cost to make one.

J. D. COX, JR.

Perfect Screws.

Editor American Machinist:

The first thing a machinist does when examining a machine tool which he intends to buy, is to take hold of the handles which are attached to the various feed-screws, and test the amount of play the screws have in the nut; or, in other words, how much he can turn the handles loosely, without moving the slide or the carriage. Seldom he has anything to say after this test. Is it because he has never found a screw absolutely without play, or does he know that the accuracy of his work, which he intends to do on the machine, does not, in most all cases, depend on this difficulty? If you go into a shop and make this same test on the various machines, you will probably be quite surprised how much back lash the screws have, either by worn threads or end play between collars. The screws are hardly ever replaced by new ones, until they refuse to move the slide at all, and yet the men are turning out good work. This is especially true in busy times. While it seems that a screw with much play in working operation is not a serious objection, it is quite an objection on a new machine with little play.

Supposing we make a screw with a compensating nut, whereby it is possible to adjust the nut in a very sensitive manner, to take up the lateral play completely, then run a screw through it 24 inches long, forward and back two or three times. Examination will show that the nut needs more adjustment. This difficulty is due to the irregularity of the screw threads. Every time the thicker threads pass through the nut, it will wear it to a certain extent, and there will be play on some portions of the screw. Now then, the question arises, Is it possible to produce a perfect screw on lathes, as they are built for the market at present? In the first place, I do not think that two lathes are made with lead screws alike.

Supposing we have two lathes with perfect screws, it is questionable whether two screws chased on these two lathes would be exact duplicates, or that the finished screws changed from one lathe to the other would not show variations by passing a tool through them. I am of the opinion that lead screws on all lathes are too small in diameter. They are subject to a certain amount of twisting strain, and will in due time get out of true, especially if heavy cuts have been taken.

There should be a lathe built specially constructed for chasing accurate screws, in which one would not be dependent on the give of the various joints between the feed-nut and the cutting-tool. On the present lathes the lead screws are too far away from the tool, the leverage being too great. A lathe for the above mentioned purpose need not have more than 6 inches swing, the spindle should be close to a rigid bed, and the lead screw located in the rear on the top of the carriage, where it can be covered partly and kept clean, and last, but not least, the tool brought close as possible to the same. We all know how important it is to have the two screws on the planer, which elevate and lower the saddle alike, in order to keep it parallel with platen at any height. The shape of the threads seems to be an unsettled question among lathe builders. We see lead screws all the way from the U. S. Standard V (flat top and bottom), to perfectly square threads. I hope to see the day when lathe builders will make lead screws uniform with correct threads. I would like to see this subject thoroughly illuminated, and am sure whatever may be said by our mechanical brethren, who have had the benefit of special experience in this line, shall certainly be appreciated by the readers of this paper.

H.

A Want in the Foot Lathe Line.

Editor American Machinist:

I am unable to find at present a small back-geared screw-cutting engine lathe, of about seven or eight inches swing, that can be used by foot-power, and made for fine and accurate work—screw cutting, etc.—with two leading screws, one to be used only for screw cutting, the other for ordinary feed. Or else one lead screw *slotted*, and operated in a sleeve gear and gearing to rack on bed, by friction operated by a knob on apron for ordinary feed, but by open and shut nut on lead for screw cutting; also a way to reverse the carriage traverse for screw cutting without running the lathe backwards. Now if you would make this want known in the AMERICAN MACHINIST, I think it would be the means of some one undertaking to make such lathes.

FOOT LATHE.

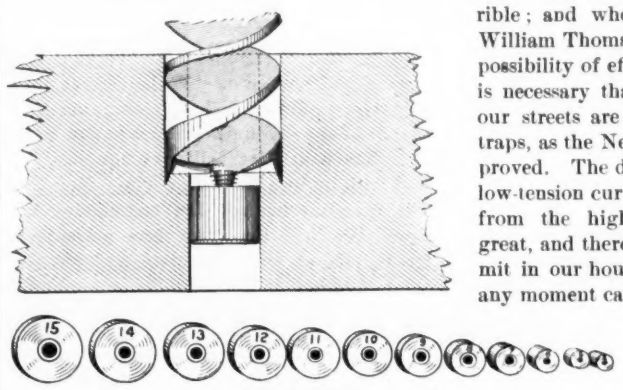
There is a disposition among many merchants and business men to be gruff, to cut off short all who have other business with them, than that which tends to the satisfaction of their greed for the mighty dollar. Canvassers, solicitors, and the like, they delight in scaring away with a frowning look, says the Philadelphia *Price List*. "They seem to take pride in never granting favors, are often vain-glorious enough to think that they are looked upon as representative business men, when, in reality, they are nothing but rough, unvarnished embodiments of a conceit as offensive as it is selfish. The man who pursues a business with a view of helping himself as much and others as little as he possibly can, makes, indeed, a dismal failure of it. Such a man is not only narrow-minded but hare-brained, and is unworthy to be ranked among the estimable class of men who measure the success of their business by the extent to which it has contributed to the success of other interests. 'Live and let live' is a maxim too often forgotten by would-be successful business men. Living in a little world of their own, they know not how to deal with the great world outside of them. They imagine that everyone who approaches them with any other purpose than to buy of their goods, is after some favor or is soliciting for some other interest, a mission which provokes in their narrow, selfish souls, feelings akin to the miser's when the place where he conceals his gold is about to be discovered."

The above, which we take from the *Pottery* and *Glassware Reporter*, contains a good large percentage of truth. The average man of the world, in his business travels, comes across a good many little men who are so great in their own estimation, that they never find time to treat other men with the respect

that forms a part of common decency. As a fact, however busy a man may be, he always has time to excuse himself, and it don't cost a cent more to do this politely than it does gruffly. No man is a gentleman, or a great man, who assumes that part of his greatness comes from treating others with disrespect, or that it is necessary to put forth efforts to impress others with an idea of his own magnitude.

Dobson's Auger Guide.

Any one who has ever tried with an auger or brace and bit to enlarge or counterbore a hole already made in wood, knows that to do it satisfactorily is not very easy. An engineer of our acquaintance undertook such a job, and not succeeding very well, devised the guide which we illustrate herewith, and which proved so successful that it has become a regular article of manufacture. It consists of a brass disk having a piece of soft metal in the center, into which is bored a conical hole, that the screw on the end of the bit goes into without danger of injury. The cut plainly shows the manner of using it. They are made in sets of twelve for holes up to $\frac{14}{16}$" diameter, by W. J. M. Dobson, 96 Albany Ave., Brooklyn, N. Y.



AUGER GUIDE.

The Globe Water Tube Boiler.

We illustrate with this a water tube boiler, the design of A. G. Brown, and manufactured by John Musgrave & Sons, Bolton, England. The Lancashire boiler has for years been the favorite in England, and as showing the considerations that led to putting this boiler on the market, and as descriptive of its construction, we quote the following from the description by Mr. Brown:

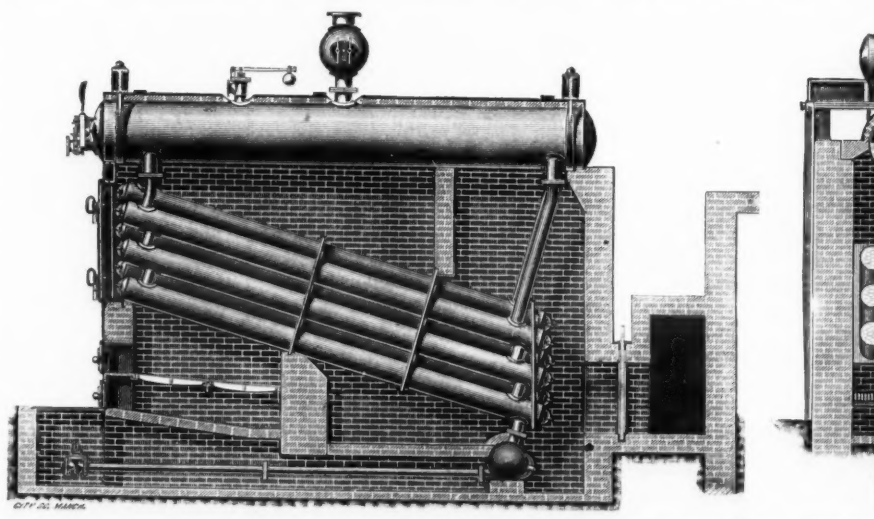
"These boilers are essentially for higher pressures than are at present in general use, the tendency being to use higher pressures and gain the benefit of the increased economy of the engines supplied. There are, however, many features that commend these boilers even for the low pressures now used.

"In designing these boilers there were three chief objects in view, and we believe these have been fully attained. The first and most essential feature is safety. This is obtained by dividing one large boiler into a number of small ones, so disposed and connected as to act as a whole in producing steam, but acting separately should accidents occur. Each small boiler, or tube, as it is called, is, from its small size, so much stronger than the ordinary large boiler, that they can safely stand a far greater pressure without risk of accident or fear of disaster. All danger is greatly lessened; in fact, it may be considered to be entirely removed.

"The second consideration was — ease and cheapness of transportation. The ordinary Lancashire boiler is an unwieldy mass, requiring special apparatus to move and special vehicles—and even special ships—to transport; cannot be taken over rough country roads, or even over good roads in mountainous districts, unless at great expense and loss of time. In place of this we divide each boiler into small sections which can be readily put together at their destination, are easily transported in ordinary vehicles or ships, and can be carried into any district and over the poorest of roads. The weight of the boiler as a whole is also much less than a Lancashire boiler of the same capacity.....

"Our tubes are 10 in. and 12 in. diameter and $\frac{1}{4}$ in. thick, small enough to render them perfectly safe, as they will stand a working pressure of 500 lbs. per square inch, a much higher pressure than is required at the present time, but still sufficiently large to render the heating surface effective. They carry a sufficient body of water to insure that the tubes never become dry through fierce firing, nor will they stop up from deposits and scale. The thickness is sufficient to allow of one-half being eaten away (equal to the whole thickness of the ordinary tube), and still leave an ample margin of strength; the waterways are large and unobstructed, and every provision is made for ease of access to all parts. Our method of connecting the tubes also provides larger and unobstructed waterways, reduces the velocity of the current of water and steam through them, allowing the steam to thoroughly separate from the water and pass off without carrying a quantity of entrained water with it. The production of wet steam, or priming, as it is called, is a serious fault of the ordinary water tube boiler. The separating surface and the volume of steam contained in the drums of this boiler is about twice the usual quantity, while the drums themselves are small in diameter."

These boilers are made in all sizes and to suit all conditions of service.



THE GLOBE WATER TUBE BOILER.

The *Northwestern Lumberman* says:

That the band-mill is growing rapidly in general popularity is strongly evidenced by the large number of circular saws which have been taken out, and are being taken out, in different parts of the country, east, west, north and south, to be replaced by band-mills. The band saw can be adapted to all kinds of wood, and the advantages derived from its use are now so well known that they are no longer disputed by wide-awake and well-informed lumbermen.

There are a good many cities in this country where scarcely a street has anything by which a stranger can determine its name. It is a short-sighted policy that makes this so; it invariably impresses a stranger unfavorably, as it seriously interferes with his finding places he is looking after. From a business point of view, no better investment can be made than that of having names of streets conspicuous.

Dangers of Electric Lighting.

In a recent letter to a Glasgow paper, Mr. Bottomly, Sir William Thomson's assistant at the Glasgow University, calls attention to the great number of deaths—over 100 in New York alone—resulting from the use of high-tension alternating currents in electric lighting in America. The high-tension system is doubtless tempting from an economical standpoint, as it permits electric energy to be distributed over wide areas with but slight loss and with small wires. But the dangers are really terrible; and when we find men like Sir William Thomson gravely doubting the possibility of efficient or safe insulation, it is necessary that we should beware that our streets are not converted into death-traps, as the New York streets have often proved. The difficulty of insulating the low-tension current from the transformer from the high-tension circuit is very great, and there are few of us would permit in our houses wires which might at any moment cause death by contact.

Another danger has also been introduced amongst us. In London, on Nov. 1st, an explosion occurred at Albert Gate, due to the ignition of a mixture of gas and air, formed by leakage under the street. by the electric arc or spark from wires passing under the street. The pavement and iron plates were blown up and sent high into the air. Fortunately there was no loss of life or injury. Our electric light companies must proceed slowly until they become familiar with the dangers of their business, if they wish to avoid discrediting the electric light and injuring themselves in the estimation of the public.—*The Practical Engineer.*

An Interesting Decision.

Almost every one would consider that the vital and essential point in the Weston pulley block was in having two chain pulleys side by side, and arranged to turn together, one being slightly larger or having one more tooth in it than the other.

The Practical Engineer, of Manchester, however, calls attention to the fact that this, which seems the very essence and gist of the contrivance, is not the feature upon which its commercial value as an article of manufacture depends, but merely upon the shape of the sheaves. An inventor named Moore, it seems, was the original constructor of a differential pulley block, which was constructed upon the same principle, differing from the Weston mainly in the use of pins or studs which engaged with the links of a peculiar chain, instead of having recesses adapted to receive the links of a common chain. The chain did not work very satisfactorily on the wheels with studs, and but few of them were made. But when the Weston block came into use, Moore brought suit against Messrs. Tangye, the manufacturers, for infringement.

The block produced in court, in the case to which we have referred, differed from the "Weston" block mainly in the fact that pegs were used in the periphery of the differential pulley, into which a flat link pitch chain geared, instead of recesses shaped to receive the links of an ordinary chain. Mr. Moore's block had not been patented, but had been repeatedly described and illustrated in scientific publications, and one had also been exhibited at a public mechanical museum; so that there could be no doubt whatever that, that if his invention really anticipated Mr. Weston's, the idea had been widely published and made public property. In that case Mr. Weston had made no invention. Mr. Moore was examined as to whether his block had been manufactured or largely used, and it transpired that only one had been made, and that it was but once used, with difficulty. It was held by the court that the difference between pins and a flat link pitch chain and recesses arranged to take ordinary link chain was a great advance, and its extensive public use proved it to be a most valuable invention. The Weston patent was therefore held to be perfectly valid, and the block was decided not to be anticipated by Moore's. In this case the change from pins to recesses, and pitch chain to ordinary chain, made all the difference between engineering and commercial failure and success.

The Steamship, Leith, Scotland, says:

"In marine boilers one of the most frequent, most annoying, and at the same time most expensive accidents (?) is the collapse of the furnaces. Those interested may possibly be pleased to learn that extensive experiments have recently been made by M. Hirsch on the causes which lead to the burning out of furnace plates, and as a result he confirms the fact, long known to experts, that under some conditions oil in the interior of the boiler is highly dangerous. The interior of a boiler to be examined was painted with oil before being filled with water, and firing in the usual way, and it was found that some oils so diminished the efficiency of contact between the water and the plates that in one case the furnace plates rose to a temperature exceeding 680°, or the melting point of zinc, when only evaporating 35 lbs. of water per square foot of grate surface."

The *London Telegraph* has some very interesting statistics of the Paris Exposition. According to the latest calculations, the number of entries between May 6 and Nov. 6 was 28,149,353. From the best estimates that can be made, 1,500,000 foreigners visited the fair, of which 90,000 were from North America, and 25,000 from South America. Strangely enough, 160,000 Germans visited the fair. It is estimated that those who visited Paris mainly on account of the fair left nearly $250,000,000 in the city. The General Omnibus Company realized more than $10,000,000.

According to the report of Secretary Tracy it will require about fifteen years for the United States to put herself on a fair footing with other nations in regard to a navy. Referring to cruisers like the Yorktown he says: "They have neither the strength to fight nor the speed to run away." Even after the fifteen years' work in the building of a navy we shall still be behind as compared with first-class European powers. What a costly thing it is, to be sure, to keep in preparation for war.

Wiggins, and Venner, and De Voe have run the weather—with some help from the Weather Bureau—for several years, but now a greater prophet than all has arisen. This prophet is "Professor" Earle, or as he is known on Jersey City Heights, "Uncle Jimmie." He predicts nineteen heavy snow-storms this winter, and railroads will get their snow-plows ready accordingly.

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Another Use for Machinery.

It is not impossible that machinists may reap some benefit, in a business way, from the movement for ballot reform, which seems to be sweeping the country. No less than two machines have been invented by the use of which it is claimed that ballots may be cast, or rather votes registered in a manner to secure all the advantages which seem to have been secured by the recently tested Massachusetts law. In both these machines, votes are registered, and the total number cast for each candidate shown on a dial, which is concealed until the voting is completed; the figures indicating the vote being brought into position by mechanism constructed on the principle of revolution counters, such as are used on pumping and other engines. All the voter has to do is to press a knob indicating his choice, the knob being so arranged mechanically, that it does not return to its place until the voter who pressed it has left the machine and been automatically shut off from access to it. The principle of the two machines is essentially the same, and their greatest advantage over the Massachusetts law seems to be that, when the voting is completed, the total vote and the total vote for each candidate is at once shown in plain figures, without the necessity for counting. But as only one voter can have access to the machine at a time, it does not seem as though voting could be done by it as fast as was done in Massachusetts, where a number of booths were provided at each voting place, so that several voters could be preparing their ballots simultaneously; the mere operation of dropping them in the ballot-box requiring but a moment's time. This difficulty it would seem possible to overcome, however, and if our method of conducting elections is to be changed (and most people concede that there is vast room for improvement) we should be glad to see the machinist taking a hand in the matter. We do nearly everything else by machinery—why shouldn't we vote by machinery? If the machinist's machine can down the politician's machine, by all means give it a chance to do so.

The Battle of the Electricians.

In the November number of the *North American Review* Mr. Thomas A. Edison presented an argument intended to show the utter futility of attempting to confine within safe bounds the high-tension alternating currents of electricity used by some other companies in which he is not himself interested. The argument seemed a very good one, and after reading it most people would be inclined to think that the only way to make a high-tension alternating system safe would be to abolish it.

But now comes Mr. George Westinghouse, Jr., with an article in the December number of the same journal, in which he seems to make out an equally good case for the other side of the question, his strongest argument, apparently, being his reference to a number of cities in which wires carrying high-tension currents underground have proven entirely safe and harmless.

In this connection it may be proper to remark, however, that Mr. Westinghouse does not mention the number of alternations per second of the currents used in the European cities which he mentions, and this probably has an important bearing on the question at issue. The successful insulation of a current of given difference of potential, and having 50 to 60 alternations per second, is a very different thing from the successful insulation of a current having the same difference of potential, but with 300 or more alternations per second; so that comparisons drawn without specifying the rapidity of the pulsation or alternations of current are apt to be misleading.

Many people will be disposed to ask why, if it is such an easy matter to make such wires safe, it is not done by those interested in them. There can be no manner of doubt that the public is being wrought up to the pitch at which it will demand that all electric wires be made absolutely safe or abandoned.

While these eminent electricians are arguing over the matter (no doubt with entire sincerity and honesty) people are continually being tortured or killed by the wires. If this can be stopped let it be done, and the quicker the better, not only for the public, but for the companies and all interested in electric lighting.

It is very poor consolation to the family of lineman Weeks to know that a high-toned journal has published an article demonstrating that the wires which deprived them of their bread-winner are the safest ones in use—or would be if put into a subway.

In this issue we publish the first of two or three articles, written by the veteran engineer, George Escol Sellers, giving the early history of the steam fire engine in this country. These articles will, we are sure, be read with interest, as they contain facts that will form mechanical and engineering history. We had expected these notes from Mr. Sellers at an earlier date, and recently received from him the following, which is explanatory and interesting:

When I removed from Bowlesville to this place [Mission Ridge] and put up an outbuilding, intending it for library and office, and as a residence while building a permanent home, I thought I could have found time to put in shape some memorandums I had made of my recollection as to the invention of the Cincinnati steam fire engine, the forerunner of all that have proved successful; but, in the huddled condition of our cramped quarters, my memorandums got misplaced. I thought that, in removing into the house, they would turn up, but they did not.

But the building—much of which was done with my own hands—was a longer job than I anticipated. When moving many days were spent in search of the lost memorandums, resulting in my overhauling vast piles of papers, the accumulation of a long life—many bundles that had remained over half a century unopened; among them I find much that may be interesting to the mechanical world, and I am now endeavoring to arrange such as may be useful as references when I am gone, but generally they are too much of a personal nature for me to make use of them. There are some things I may put in shape, but when a man is in his eighty-second year it is not safe to make rash promises. It is only recently that the lost memorandums have turned up. I forward you the results by registered mail. I do so as they are as originally written, and my eyes will not permit me to make a copy.

How application to what is at hand to enrich a community works, cannot be better illustrated than in the instance of the State of Vermont. Vermont is a small State, with a small population, and her mountains and rocks are more ornamental than useful. But there is in the State certain possibilities in the way of mines of gold and silver, not especially valuable, and slate and marble quarries that are valuable. In 1870 the total product of these mines and quarries was only $905,410.

In 1880 this had grown to $2,273,366, and in 1888, partly by estimation, to $7,000,000. The *Vermont Phœnix*, from which we take the foregoing, speaking especially of the granite product, says, quite too modestly, if that is possible:

The demand is in excess of the supply, the supply is inexhaustible, and the next ten years is likely to see a growth far greater than that of the last ten.

We say quite too modestly, for, with some knowledge of the wealth Vermont possesses in her granite quarries, there need hardly be a limit to what may be done in that direction.

The notion that it is the opinion in New York that there is not time enough to prepare for the World's Fair, in 1892, appears to be gaining ground outside the city. We do not believe that in the city there is such opinion to any great extent. It was well known at the beginning that the time was short, but we believe there is time enough, if it is properly used. Settling down and pottering over a thing for four or five years has brought many a promising affair to grief. A good deal of work can be done before the middle of 1892, provided getting ahead with it is not strangled by too much machinery of organization and supervision. With the present use of electric lights, work on the buildings can, if necessary, be prosecuted day and night. With money enough at hand, the right kind of men in charge, and the soonest possible stand made, the buildings will be ready.

The United States will go right on from this time, putting a great amount of money into a navy, and Americans, very properly, will be proud of it. Yet all this expenditure will produce nothing to make the world happier or better. What an excellent thing it would be for the man who works to produce what we eat and drink, and use, if there were no navies in the world. It would mean for him either so much less work, or so much more of the comforts of life.

In a city near New York, well located for manufacturing purposes, there are taxes remaining unpaid on property to the extent that the unpaid sum is greater than that for which the property would sell. Yet the wonder of the citizens is: Why do not more manufacturers locate here? It isn't much of a conundrum when it is considered that these manufacturers would be called upon to make up in taxes what others will not pay.

Literary Notes.

Hints on House Building: Some Desultory Notes in Popular Form, mostly reprinted from the Mechanical News. By Robert Grimshaw. Second and Enlarged Edition. New York: Practical Publishing Co.

This little book contains hints that we should think would be valuable to those about to buy a lot and build a house. No attempt is made to present a complete work on the subject, but, as the title indicates, to supply some hints.

QUESTIONS AND ANSWERS

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(457) G. K., Barton, Vt., asks: Will you please tell me what is the proper speed to run dies for cutting bolts? *A.*—There is no one speed which is proper for all cases, but 15 to 20 feet is about right for most cases.

(458) J. B., New York city, asks: Will you tell me how graduations are made on machinists' scales? Are they stamped in or cut out, one or more at a time? Can I get a description of a graduating machine in any of the back numbers of the AMERICAN MACHINIST? Tell me how the sharp V is made in center and thread gauges. *A.*—Graduations on steel rules are cut. We have published no description of such a machine. The Vs are milled in such gauges as you speak of.

(459) G. S., N. Y., writes: Will you please give me a method for hardening mill-picks for soapstone works? I am unable to bring them to the degree of hardness sufficient to make much of an impression on the stone. *A.*—We think there is much more hope of overcoming a difficulty of this kind by the proper selection of steel than by attempting to secure hardness by any special process. Our advice would be to write to a manufacturer of steel, telling him what you desire to do and the trouble you have encountered.

(460) J. M., Jeffersonville, Ind., asks: Is there a rule for determining the area and height of smoke-stacks for boilers? For example, I have two boilers, 24 feet long, 42 feet diameter, two flues in each, 16 inches diameter. What should be the area and height of the smoke-stack for these boilers? *A.*—In practice the cross-sectional area of the chimney varies from one-sixth to one-tenth of the grate. In order to find the height, it is necessary to know the number of pounds of coal consumed under the boiler per hour; this data you have not given. On general principles, we should say that you will need a chimney 30 inches square inside, and 60 feet high. In our issue of April 23, 1887, you will find a table of chimney proportions. 2. Which kind of chimney is the best, a square or a round one? *A.*—There is very little difference between the two, as far as draught is concerned. Square chimneys of moderate diameter are cheaper to build.

(461) J. P. L., ———, writes: I would like to learn some formula or rule for compounding gears on an engine lathe for cutting fractional threads. I have seen but one, and it is so complicated that I do not understand it. I would like to obtain some book that would explain the subject. *A.*—We know of no book on this subject, but you will find a rule which is stated as plainly as we can state it in the answer to Question 70, issue of February 14, this volume. 2. I would also be pleased to have you explain the method of reading a vernier, or tell me what book I can get that will give information. *A.*—You will find the subject fully explained in works on surveying.

(462) "Punch," ———, asks: In the manufacture of small plate washers, such as are used on bolts, are the washer and hole punched at one and the same time, or does it require two operations? If a washer is finished at each stroke of the machine, can you explain how it is done? *A.*—It is sometimes done by having two punches and dies side by side in the machine, one punch and die being the size for the hole, the other for the outside of the washer. The strip from which the washers are made is fed in, so that the small punch first operates upon it, and in this way, after the first stroke, a washer is completed at each stroke. This principle, it is obvious, may be extended to include more than two punches and dies when circumstances admit.

(463) F. M. T., Torrington, Conn., asks: What is the difference in temperature of steam at 50 pounds and at 5 pounds pressure? *A.*—The temperature of steam at 5 pounds pressure is 227.9 degrees Fahrenheit; at 50 pounds pressure it is 297.8 degrees, making a difference 297.8 — 227.9 = 69.9 degrees. Nearly all books which treat on steam have tables giving the temperature corresponding to the different pressures of steam. The pressures given in these tables are absolute; hence, in using these tables, 15 pounds should be added to the pressures indicated by the steam gauge. Thus, for instance, in finding the temperature of steam at 5 pounds pressure by the steam gauge, we look for 5 + 15 = 20 pounds in the table, and take the corresponding temperature. The temperatures here given are for saturated steam.

(464) E. A. H., Chicago, Ill., asks: 1. What metal in the shape of, say three-eighths of an inch round rod, would show the most expansion lengthwise? *A.*—Zinc. 2. At what temperature would it begin its expansion, and how high degree of heat could it attain before melting? *A.*—Zinc, or other metals, expand as soon as heat is applied. The melting point of zinc is 780 degrees Fahrenheit. 3. In what ratio would it expand as to its temperature, that is, if at 200 degrees it expands at one-eighth of an inch, would it expand one-fourth of an inch at 400 degrees? *A.*—The expansion is not quite regular for equal intervals—as degrees—of heat. The variation in this respect is not, however, sufficient in extent to be of great importance to the man who wants to know something about the matter for practical purposes. Zinc will expand .00017 of its length for every 10 degrees of increase of temperature, very nearly.

(465) C. P. D., ———, asks: Will you please give me a plain explanation of the difference between a pinion and a spur gear? *A.*—The precise dividing line between a gear and pinion has, we think, never been drawn, though some authorities say that, of two gears working together, the larger one is termed the wheel, the smaller the pinion. This, however, we do not think agrees with general practice, as it is not customary among mechanics to so designate them when both wheels are large and nearly the same size. According to customary usage among mechanics, we should say that a pinion was a toothed wheel having not more than thirty teeth, and working with a wheel not less than twice its size. 2. Can you tell me how a tap, 25 or 30 inches long, such as is used for stay-bolts, can be tempered without being badly sprung? *A.*—Anneal the steel at a uniform heat, and, after the tap is roughed out in the lathe, re-anneal it. Then, in hardening it, see that the heat is exactly uniform, not only at the moment of dipping, but at each stage of the heating process. This can best be done in a muffle or furnace.

(466) H. B., Reynoldsville, Pa., writes: We have a slide valve engine, 26″x32″, running at the rate of 90 revolutions per minute, with 90 pounds of steam. We would like to know what size of fly-wheel to put on the engine. Please give weight and diameter. *A.*—Diameter of wheel 16 feet, weight, 8,200 pounds. The diameter of the wheel is a matter of good judgment; the dimension here given may not be suitable for the space which the engine has to occupy, or may not conform to other conditions. A change in the diameter will necessitate a change in the weight. The following rule for computing the weight, we have taken from the Buckeye Engine Company's catalogue, and will give equal efficacy for different diameters and speeds, and about the maximum requirement for any duty, except, perhaps, for rolling mills and similar cases. Divide the constant number, 12,000,000, by the squares of the diameter of the wheel in feet, and of its revolutions per minute, and multiply the quotient by the area of the piston in square inches, and by its stroke in feet. The product will be the required weight of the rim, assuming the engine properly loaded. To illustrate, we will apply this rule to the case here given, deciding that the diameter of the fly-wheel shall be 16 feet. The square of the speed is $90 \times 90 = 8{,}100$, and the square of the diameter of the wheel is $16 \times 16 = 256$. The area of the piston is 530.93 square inches, and the stroke is 2.66 feet. Now, according to rule, we have

$$\frac{12{,}000{,}000}{256 \times 8{,}100} \times 530.93 \times 2.66 = 8{,}162.94 \text{ pounds, say } 8{,}200 \text{ pounds.}$$

A fly-wheel is of sufficient capacity when the periodical fluctuations are insufficient to produce any detrimental effect on the character of the work performed, either directly or through disturbance of the action of the governor, or to be distinctly noticeable to the observer. But the amount of wheel necessary to satisfy these conditions varies greatly with the nature of the machinery driven; some kinds assisting it more or less, and others being neutral in that respect, or even antagonistic. Also the demands in the direction of speed uniformity are more exacting with some duties than others. Electric lighting is the most exacting duty in this respect, as fluctuation that could not be detected in other duties will produce very objectionable unsteadiness in the lights produced. In some cases two-thirds of the weight found by the foregoing rule will be sufficient; too much wheel is a constant source of loss from friction. Experience and good judgment are required for designing a fly-wheel.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Gear wheels and g-cutting. Grant, see adv., p. 16.

Link-Belting and Sprocket Wheels.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Engineering Co., Philadelphia and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc., J. B. Roney, Lynn, Mass.

Fine Tools and Gauges. R. M. Clough, Meriden, Ct.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. Vanderburgh, Wells, & Co., cor. Fulton and Dutch sts., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Prestoline & Prestoline Paste, for cleaning & polishing metals. S. A. Smith, 23 S. Canal st., Chicago.

Ice and Refrigerating Machines, 140 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Iron Planers from 16″ to 36″ wide by any length. H. C. Pease & Co., Worcester, Mass.

New Catalogue of Screw Plates, Taps, Dies, etc., just issued by S. W. Card & Co., Mansfield, Mass.

Patent Attorney. R. G. DuBois, 715 11th st., Wash., D. C., procures first-class patents for inventors.

Crank pin Machines. Pedrick & Ayer, Philadelphia, Pa.

Planer Chucks—Greenwood's Universal. Pedrick & Ayer, Philadelphia, Pa.,

Latest and best Expanding Reamer. Patent for sale. J. E. McConnell, Des Moines, Ia.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Most sensitive and durable Damper Regulator made; works within one pound; send for circular. T. Kieley, 11 W. 13th st., New York.

For the latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

The hook on steam engines is being supplanted by the Dill disconnecting device made by the T. C. Dill Machine Company, 726 Girard ave., Phila., Pa.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See Dec. 12, p. 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

25″ 28″ 32″ 36″ Upright Drills a specialty. Finely made, great capacity, quickly operated, prices low. Send for list of firms using our Drills. J. E. Snyder, Worcester, Mass.

25″ 32″ 37″ 42″ "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, New Ark, N. J.

Standard Reducing Valve, Standard Pump Pressure Regulators, Improved Collignon Cylinder Oil Pumps, Jenkins Globe and Angle Valves. Send for circulars. Standard Regulator Co., Buffalo, N. Y.

Steam Boilers: Their management and working on land and sea. By Jas. Peattie. Practical facts from 30 years' experience. 230 pages. Illustrated, 12mo., cloth, $2. Circulars and Catalogue of Books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N. Y.

De Lamater Screw Propeller Wheel made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

H. B. Roelker, 22 Cortlandt st., New York, late Sup't De Lamater Iron Works, will hereafter manufacture the De Lamater Screw Propeller. Propellers of same pattern and workmanship as formerly made by the De Lamater Iron Works. Each designed for its special work at lowest prices. Consulting Expert and Constructing Engineer. Estimates made on machinery and on damages.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

Patterson, Gottfried & Hunter (Lim.), 146-150 Centre st., N. Y., carry a complete stock of Brush, Copper, Celluvert Fiber, Oiled Paper, Hard Rubber, Rod & Sheet Brass, Brass, Copper & Iron Wire, Self-Hardening Tool Steel, Set & Cap Screws, Machine Bolts, Machine & Wood Screws, Taps & Dies, Files and Twist Drills, Blowers & Forges, Machinery, Tools & Hardware, Gear Wheels, Wood Pulleys, Shafting, Hangers & Belting. General factory supplies.

"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 105 articles have thus far appeared up to and including the November 28, 1889 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Practical Drawing." By J. G. A. Meyer. The above series of articles now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including Dec. 5, 1889 issue, 91 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

C. H. De Lamater & Co. have closed their extensive manufactory at the foot of West 13th street, New York, and have sold the Hot Air Pumping Engine and Steam Pump business to the De Lamater Iron Works (incorporated in 1889), and the Propeller Wheel business to the Samuel L. Moore & Sons Co., of Elizabethport, New Jersey.

In order to close out the remainder of the stock, offer for sale a very desirable lot of machinery, such as lathes from 15″ to 88″ swing, planing machines 48″x45″x10′, 53″x50″x12′, 17″x14″x24′, 72″x69″x24′, and various other sizes; drilling machines, slotting machines, shaping machines, boring machines, bolt-cutting machines, cutting-off machines, nut tappers, milling machines, gear cutters, emery tool grinders, portable drills, screw-cutting machines, vises, lathe and planer tools, and a variety of small tools; also traveling and jib cranes.

Punching and shearing machines for boiler makers, with a general outfit of small tools. Blacksmiths' tools, such as anvils, sledges, tongs, etc. Pattern lathes, benches, saws, screws, nails, and a general supply of small tools. Foundry cranes, cupolas and small tools. Blocks, ropes, bolts, nuts, washers, packings, pipe and fittings, iron and brass valves. Boiler iron, steel plate and boiler rivets. Bar iron and steel, also steam hammers and two 8″x16″ and one 10″x20″ Rider cut-off engines.

MANUFACTURES

The Orswell Cotton Mills, Fitchburg, will build an enlargement to the plant.

The Kershaw County Alliance expect to build a cotton mill at Camden, S. C.

The Northwestern Wind Engine Co. has been incorporated at Minneapolis, Minn.

The R. D. Cole Manufacturing Company is enlarging its machine shop at Newnan, Ga.

McIntosh, Hemphill & Co., Pittsburgh, Pa., have voluntarily advanced wages 10 per cent.

The Rogers Furnace Co., of Detroit, has been incorporated, with a capital of $100,000.

There is an effort at Windsor Falls, Conn., to start the Windsor Locks Electric and Power Company.

The Newport Tool Company has been organized at Newport, Ky., for the manufacture of edge tools.

A company to be known as the Cycloidal Engine and Pump Company has been organized at Keokuk, Iowa.

The North Carolina Steel and Iron Company has been organized at Salisbury, N. C. Reported capital, $1,000,000.

A $100,000 stock company will be organized shortly, to secure the erection of a cotton mill at Americus, Ga.

John Leary, of Philadelphia, Pa., is making efforts to secure the erection of a large cotton factory in Albany, Ga.

There is an animated stir amongst New Bedford (Mass.) capitalists in the direction of building several cotton mills.

The Adams & Price Machine Works, Nashville, Tenn., are finding it necessary to add several machine tools to their plant.

The Central Falls Woolen Mills, of Central Falls, R. I., which have been shut down for the past two weeks, resumed operations recently.

The starting of a cotton mill at Vicksburg, Miss., by W. McArthur, hinges upon the taking of $50,000—one-half the stock—in the city.

The Pelton Water Wheel Co., San Francisco, Cal., has recently added to its capacity by a new building, giving 7,000 feet additional floor space.

The new yarn mill which the Cohannel Company is building at Weir Village, Mass., will be 400 feet long and three stories high. It will be built of brick.

The Missouri Pacific Railway Co. will enlarge their shops at Argenta, Ark. It is also reported that the company will build a new shop at Little Rock, Ark.

The Long & Allstatter Co., Hamilton, are adding a story to their main building. The building is 60x200, and the improvement will make it four stories high.

The Lone Star Novelty Works is the name under which a concern at Fort Worth, Tex., is building a factory where sash, doors, blinds and novelties from wood will be made.

The Delvirmar Silk Association has been organized in Wilmington, Del., with $50,000 capital, to conduct the various branches of silk culture. A silk farm for this purpose will be established near Wilmington.

The Gleason & Bailey Manufacturing Company, Seneca Falls, N. Y., have broken ground for a large foundry and machine shop at Aurora, Ill. This will be the headquarters of the Western branch of the company's business.

H. Belmer & Co., the Cincinnati Barb Wire Fence Company, and others, have incorporated the Ohio Valley Steel Company, of Cincinnati, with a capital stock of $400,000, to manufacture rods, steel wire, wire mats and barb wire.

On Wednesday last a charter was issued at Harrisburg to the Greensburg Steel Company, of Greensburg. Capital, $100,000. The directors are: Robert S. Jamison, A. C. Isaacs, J. Clark Williams, Thomas Donahoe and John Kuhnes.

Abington, Mass., is to have a new electric light company, to supply Abington, Rockland and North Abington. The capital stock will be $40,000, and 60 arcs and 1,300 incandescents will be put in. Among those interested are H. B. Pierce, C. N. Cobb, M. N. Arnold and E. P. Reed.

The Canton Steam Pump Company, of Canton, O., was lately reorganized, and, although various propositions to move the company's shops were considered, it was decided to remain in Canton, and they will be located in the plant of the J. H. McLain Machine Company.

Donahue & White, Lynn, Mass., morocco manufacturers, who were burned out in the great fire, have hired a leather factory in Salem, Mass., with its engine, boiler, etc. The factory has been vacant quite a long time, but things will be rushed so that business can be started soon. The firm will employ a large force.

The Hoppes Manufacturing Co., Springfield, Ohio, send us their new catalogue of feed-water purifiers and exhaust steam feed-water heaters. In addition to illustrating and describing what they make in these lines, the catalogue contains general information on the subject of heating and purifying feed water that will be of interest to engineers.

Messrs. Carnegie, Phipps & Co., of Pittsburgh, Pa., will give Southern Bessemer pig iron a trial. Recently, it is reported, 2,000 tons of this material was ordered from a Talladega (Ala.) furnace company, and at the Homestead Works the pig will be given a practical test. The arrival of this iron, it is said, will be the first considerable quantity of the Southern article that has been brought into that district.

The Middletown Machine Company, of Middletown, Ohio, have organized and been incorporated. They have purchased the machine works of Chas. W. Shartle, known as the Middletown Machine Works. They are paying special attention and filling large orders of their two specialties, Shartle's lathe dogs and Sharlie's patent safety set collars, which are finding a ready market in Europe as well as at home.

The Brown & Sharpe Manufacturing Co., Providence, R. I., have issued an illustrated supplement to their regular catalogue. In its arrangement and typography the supplement is really a work of art. In their notice they say: "In publishing our annual catalogue for many years we have selected a small size as the most convenient for general circulation and reference. The books can be easily carried in the pocket, and are excellent for every-day use. The majority of our tools, moreover, are of such a character that they can be clearly represented by comparatively small cuts. Occasionally, however, larger representations of some of the machines and tools are desirable, and we accordingly publish enlarged illustrations in the following pages, in the form of a supplement to our catalogue. Opposite the illustrations of machines we have placed cuts of operations that indicate, though, of course, in a very general way, the lines of work in which the machines are used. For other illustrations of this kind we refer to our various circulars, pamphlets and treatises. The catalogue is mailed on application, and the supplement on receipt of 15 cents."

Some Vermont towns, and others elsewhere, sent representatives to Lynn with a view to secure the location of some of the burned-out employers, but the result was that the manufacturers expressed themselves as well satisfied with the way they had been treated in Lynn, and proposed to continue business there. Referring to this, the Boston *Herald* says: "Inducements of an unusual nature are being offered to manufacturers to leave Lynn, committees by the score visiting the city from innumerable country towns, in the endeavor to take away the city's business. But it is not believed they will succeed. Lynn citizens appear loyal to the city, and those who go away say they are only to do so temporarily. Jones, Curtis & Towne and other manufacturers propose taking lofts in Boston while factory accommodations are being secured for them in Lynn. Their help can then travel from Lynn at a moderate fare. This is thought to be an advisable plan by numerous manufacturers. Some building owners in Lynn are placing rents at a very high figure, so much so as to cause adverse comment. Salem will get much benefit from the factory work there by Lynn men, some of whom will dwell there. The hopeful feeling continues, and all appear to do that which is for the best interests of the municipality. 'Loyalty to Lynn' is the watchword at the present time, and it will be warmly agitated." Speaking from general principles, this shows good common sense on the part of Lynn manufacturers.

Machinists' Supplies and Iron.

NEW YORK, Dec. 14, 1889.

Iron.—American Pig.—Prices for 1890 deliveries are still unsettled, and consumers evince much more anxiety to place orders than producers are to have them placed. Those who buy iron for immediate delivery are paying for 1 X foundry, $19 to $19.50, and for special brands as high as $20.50. No. 2 we quote at $18 to $18.50.

Scotch Pig.—The demand is quite limited, and it seems evident that its use will continue to decline in this country, owing to the increased use of Western and Southern irons as softener instead. Quotations are very uncertain, but prices continue high, owing to the demand nearer home. The best brands are quoted at $26.50 to $27.50; other brands range from $24 to $24.50.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—Position by a mech. engineer with 10 yrs. exp. in designing modern mach'y. Box 60, AM. MACH.

Exp'd draftsman and mach't desires engagement as draftsman or ass't sup't. D. 9, AM. MACHINIST.

Foreman and contractor wanted, who can handle men and do good work promptly. Address Steam Engine, care AMERICAN MACHINIST.

Wanted—Draftsman that understands traction engine and saw-mill work. Address Ritchie & Dyer Co., Hamilton, Ohio.

Wanted—Practical foreman, good mechanic, for manufacturing drills, reamers, taps and small tools. Address Box 40, Chester, Pa.

Wanted—Foreman boiler works who can manage about 25 men and get out good work at lowest cost. Address A. J. P., AMERICAN MACHINIST.

Drop die sinker wanted. First-class man only. Give experience, age and price. Wyman & Gordon, Worcester, Mass.

Wanted—Situation in foundry to make snap flasks and follow boards. 15 years' experience in sewing machine foundry. Box 59, AMERICAN MACHINIST.

Wanted—Good agents to sell on commission the Combination Pump and Heater. See ad. with cut of the machine. D. E. Rice, Detroit, Mich.

Situation wanted by a Stevens Institute graduate as draftsman in marine engine works. 3 years' exp.; moderate salary; 1st-class refs. Marine, AM. MACH.

Practical boiler maker—has been foreman 15 years—desires position. Best reference as to ability, etc. Address Boiler, AMERICAN MACHINIST.

Machinists Wanted—Vise hands accustomed to first-class work. Steady employm't and liberal wages guaranteed. Have largely increased our plant and need more men. Niles Tool Works, Hamilton, O.

Wanted—Foreman for blacksmith shop and ass't foreman for foundry. None but men alive to improved methods need apply. State experience and salary expected. Box 58, AMERICAN MACHINIST.

Wanted—Mechanical engineer as sup't in shops doing engine, boiler and foundry business. To the right party, having a little money to invest, an interest would be given. Address B., care AM. MACH.

Wanted—Draftsman with experience in hydraulic machinery, as assistant to head draftsman. Address J. R. Clay, care Smith & Vaile Co., Dayton, Ohio.

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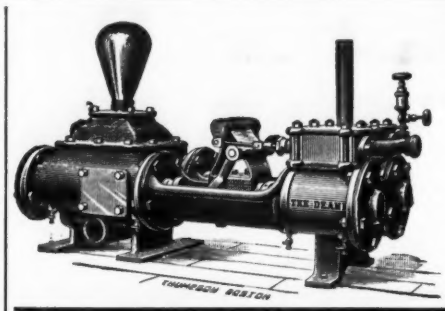

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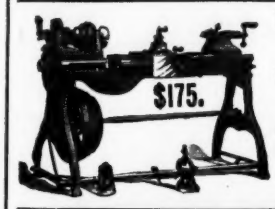

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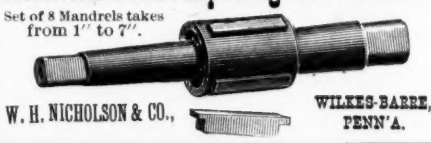

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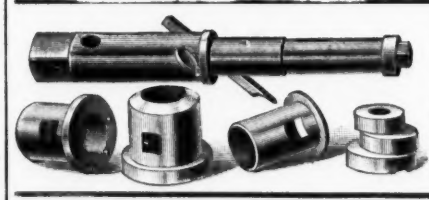

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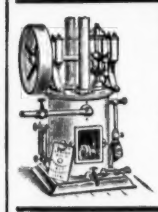

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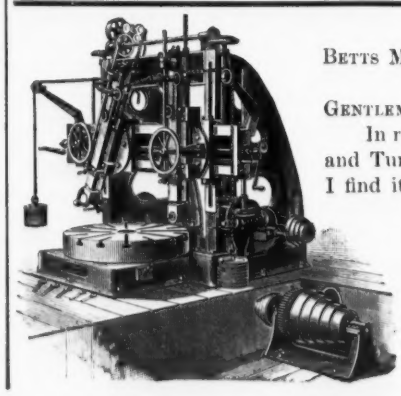

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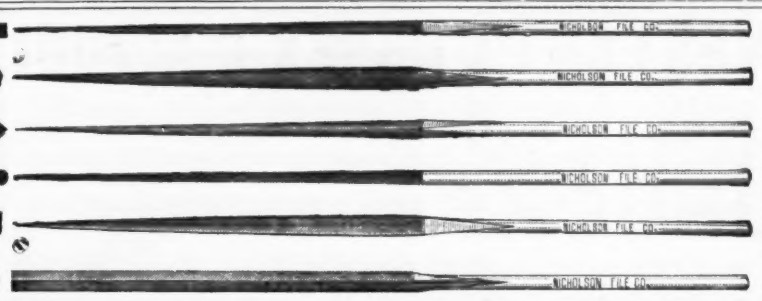

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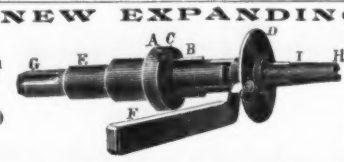

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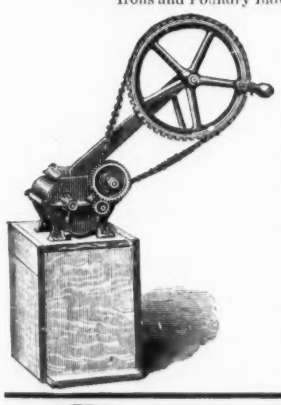

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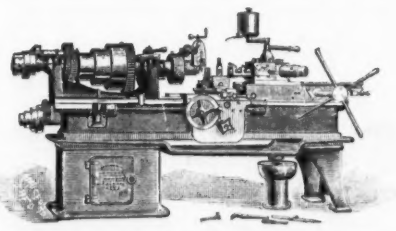

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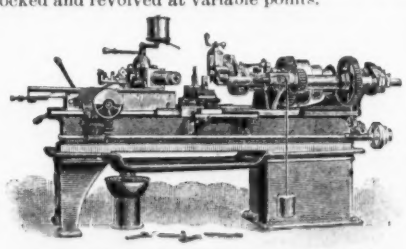

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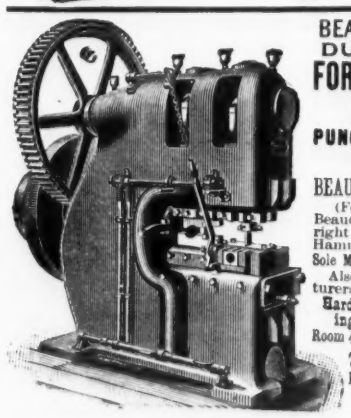

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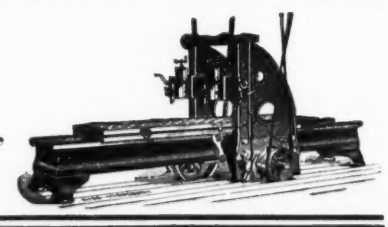

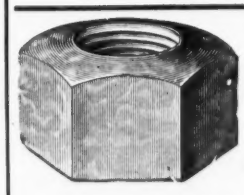

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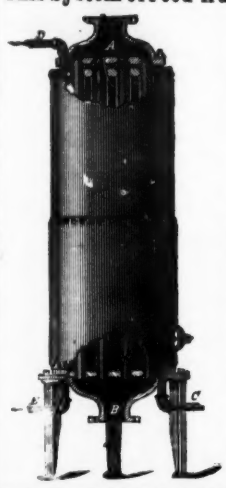

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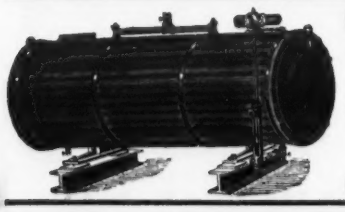

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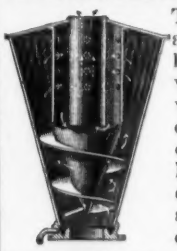

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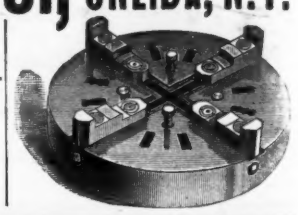

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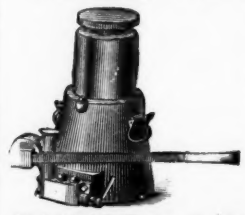

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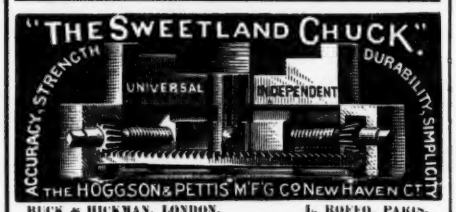

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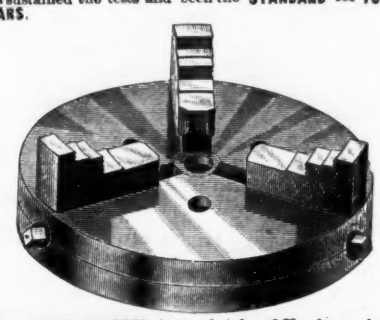

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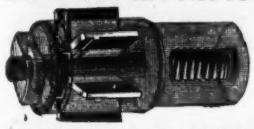

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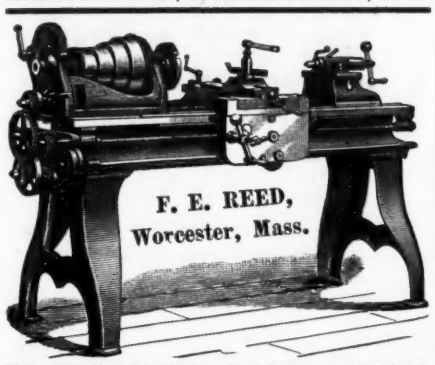

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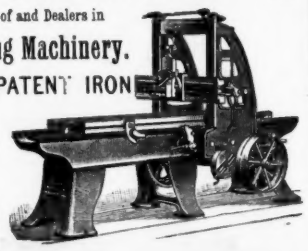

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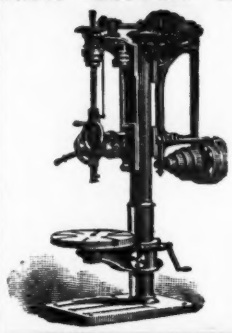

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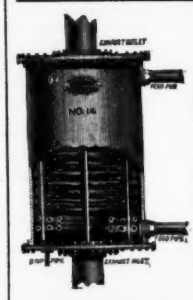

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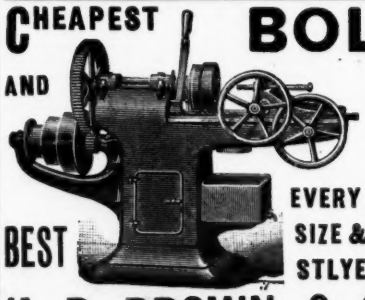

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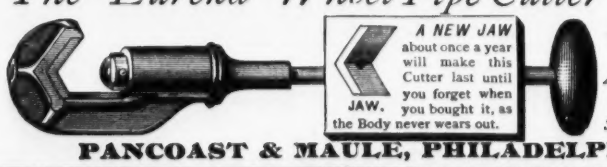

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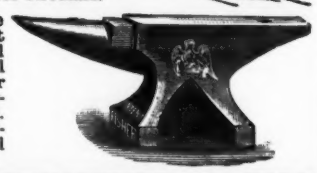

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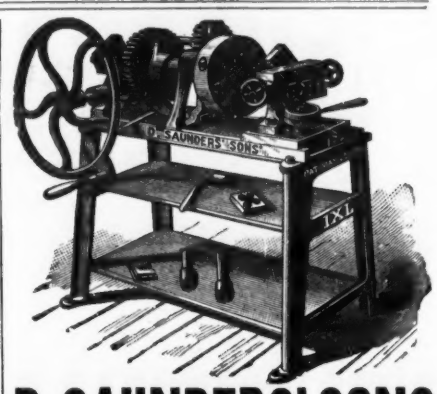

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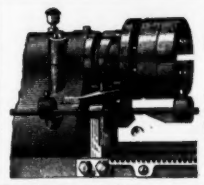

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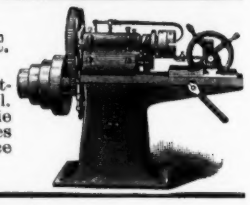

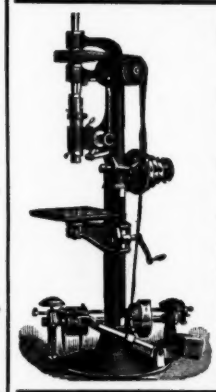

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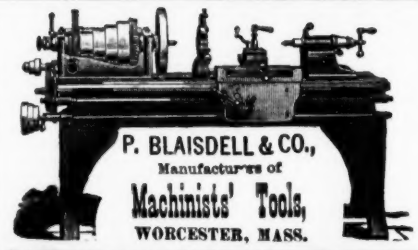

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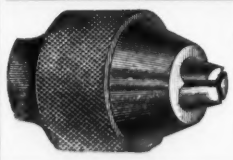

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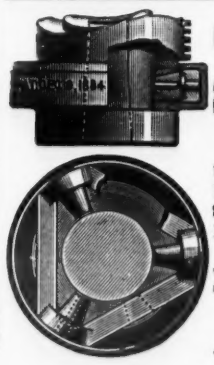

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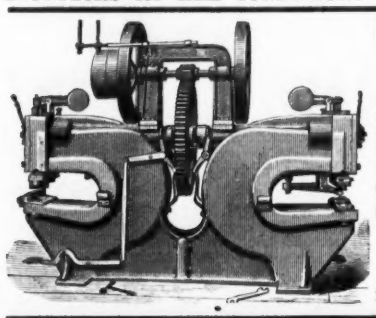

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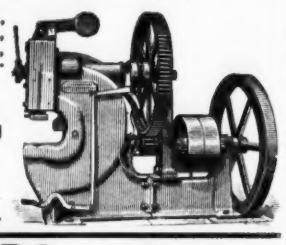

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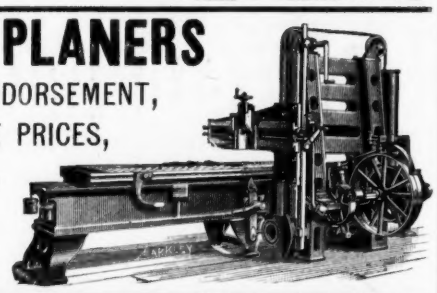

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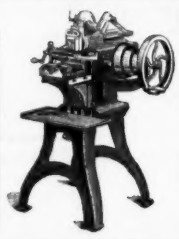
Manufacturers of Set, Cap & Machine Screws, Studs, etc.



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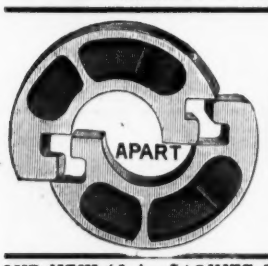

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We present this tool to the Brass Working Public as a specimen of the progressive ideas called forth by heavy competition which manufacturers are constantly meeting.
While it is a tool of the most elaborate design, having all the best features that are incorporated by the best manufacturers of this class of machinery, it is so simple that comparatively unskilled labor may be used in its operation. *It is a fact that a first-class arrangement for boring and turning tapers by power, that will make nice smooth holes, has been greatly needed for a long time past. This machine will do this without setting the head askew and throwing the belt awry, and at the same time while tapers are being bored, square surfaces may be faced at right angles to center line without a single change being made either in the head or the turret slide.* This movement is obtained by a specially designed and simple arrangement for moving the cross slide of turret; while carriage is held the turret is traveling in a straight line.
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It will enable you to taper with absolute nicety, thousands of taper holes, and is not in the least detrimental to the general utility of the machine.
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It is provided with power feed for carriage, reverse motion of feed for running backward or forward without stopping the machine.
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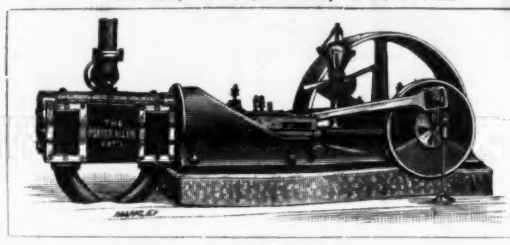

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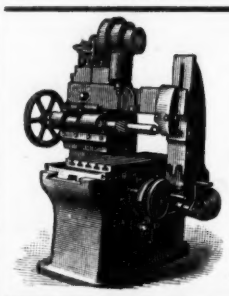

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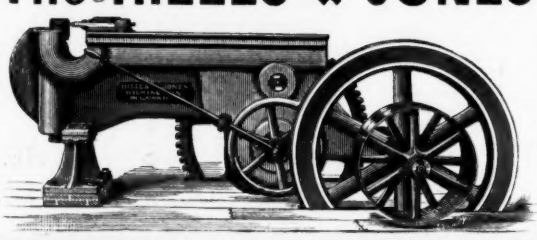

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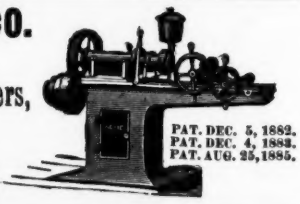

PAT. DEC. 5, 1882.
PAT. DEC. 4, 1883.
PAT. AUG. 25, 1885.

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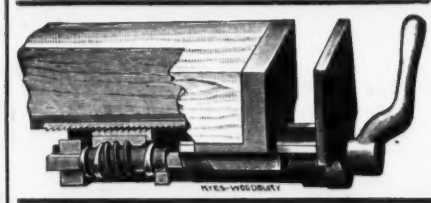

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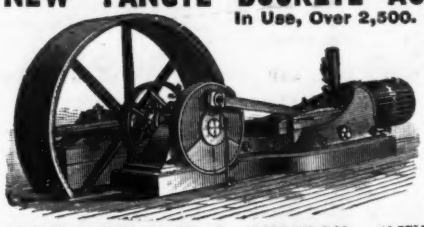

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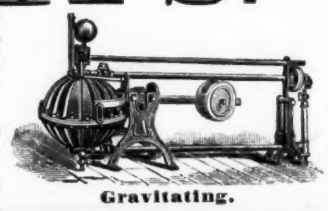

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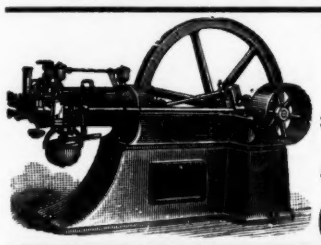

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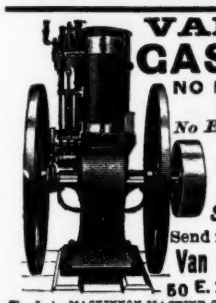

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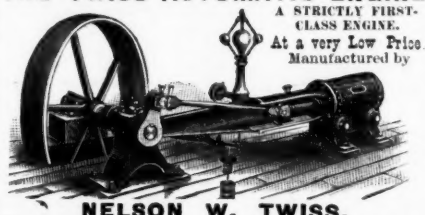

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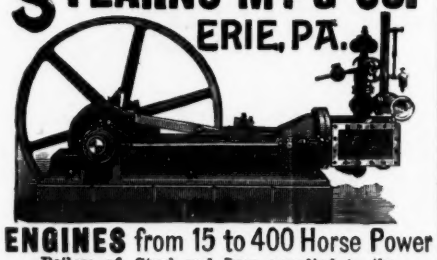

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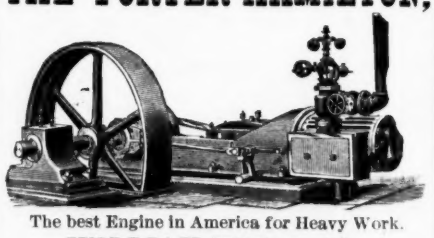

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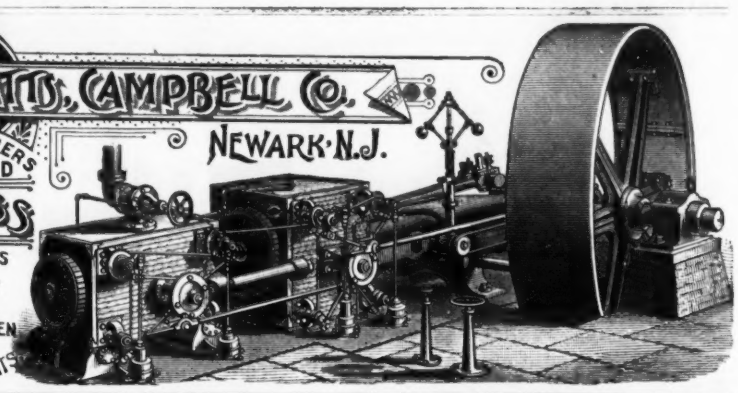

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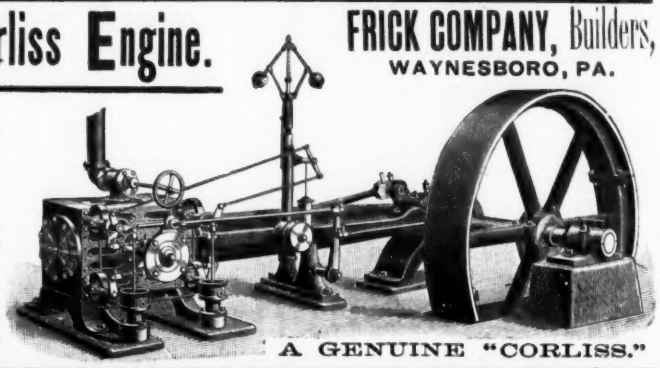

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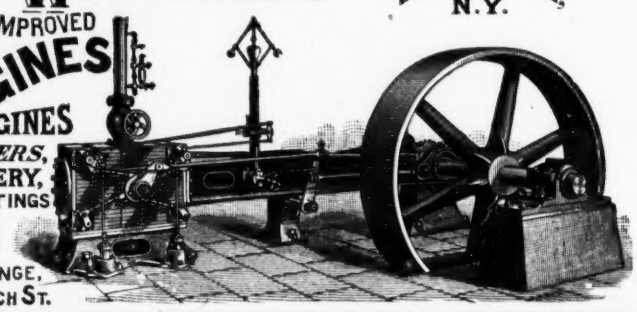

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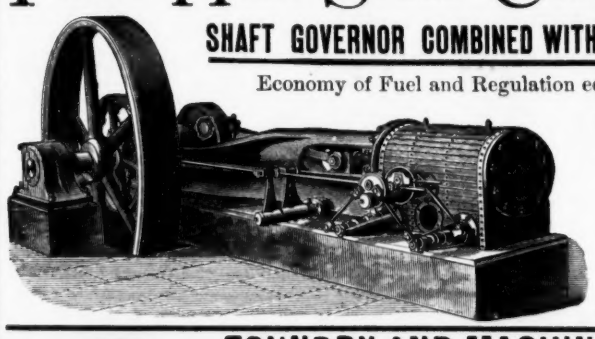

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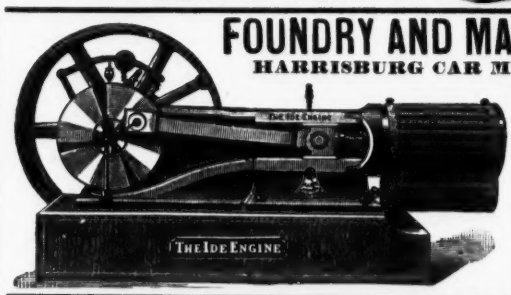

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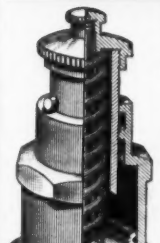

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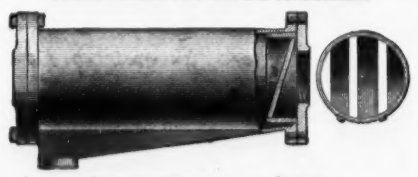

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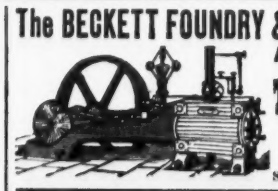

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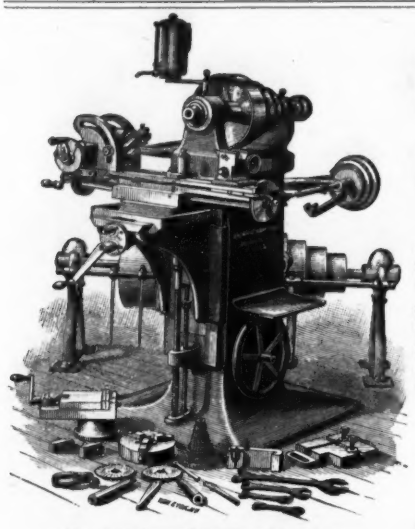

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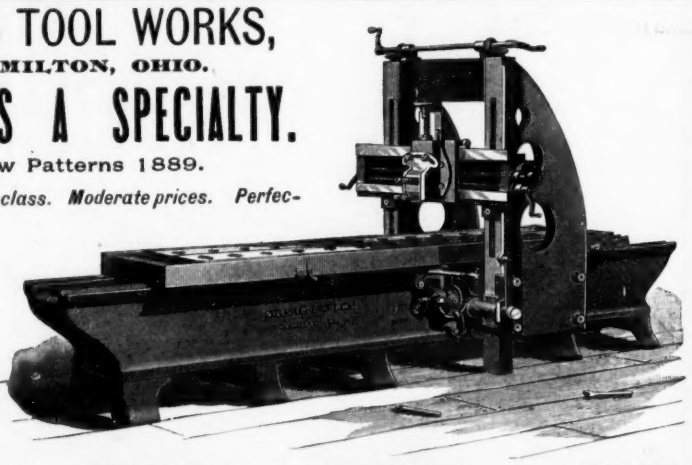

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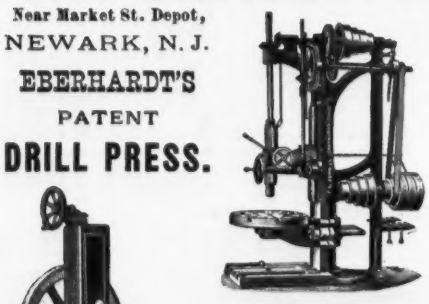

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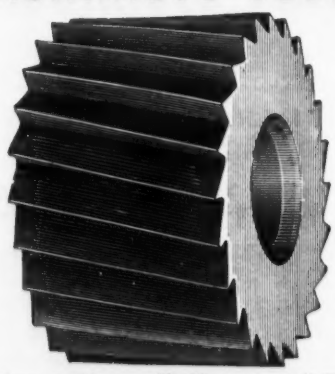

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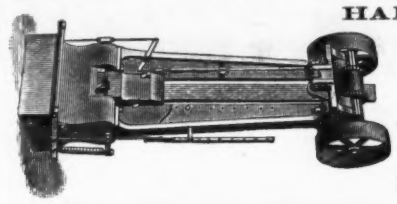

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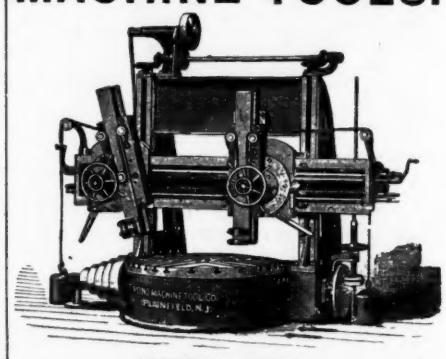

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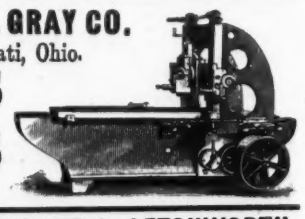

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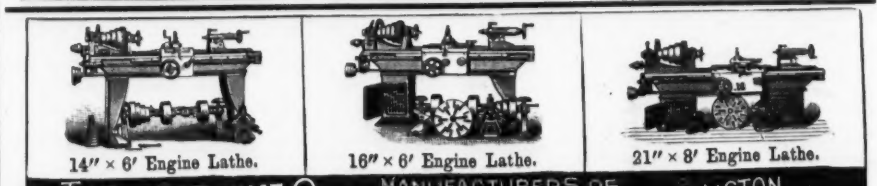

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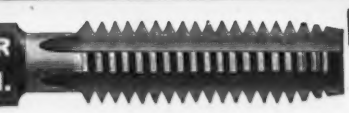

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